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BRIEFLY TOLD.

OBITUARY NOTE—MR. GEORGE BENJAMIN NEAL.—The JOURNAL for July 15th contained brief mention of the death of Mr. George Benjamin Neal, of Charlestown, Mass., who passed away, in the Massachusetts General Hospital, Boston, Mass., the afternoon of Sunday, July 7th. Mr. Neal had for years been a sufferer from hernia, and his death was eventually through that cause. On the 3d of July he visited the hospital, to undergo a comparatively simple operation, and he came out of the ordeal seemingly safe; but the strain on his system was beyond his recuperative powers, and, slowly sinking, the inevitable was reached without pang or struggle. George Benjamin Neal was born in Newton Lower Falls (which is now in reality a part of the city of Newton, Mass.), May 21, 1823. His primal education was obtained in the Seth Davis School, of Newton, and was completed in Harvard College, from which sterling institution he graduated with the Class of 1846, a Class noted for having in its membership such men of later world-wide fame as Prof. Charles Eliot Norton, Senator Hoar and Prof. W. A. Lane. Electing to follow a lawyer's career, after a studious course in the Harvard Law School, and later a practical trial in the office of Mr. G. W. Warren, of Charlestown, Mass., he was admitted to the bar. His activity and aptitude speedily attracted the close attention of Mr. Warren, who was the first Mayor of Charlestown, and who was also the first President of the Charlestown Gas Company, which enterprise was chartered in 1851. In 1852 the Company was ready for active business, and Mr. Neal accepted the place of Clerk and Treasurer in its service. From then to the time of his death he was the active man in its management. That he served it well and faithfully needs no statement in proof thereof from us. He was one of weight in the Company when the matter of taking up the supply of electric currents in Charlestown was broached, which consideration finally resulted in the changing of the title of the corporation to that of the Charlestown Gas and Electric Company. The young lawyer as a commercial manager justified the sagacity of Mr. Warren in his naming, and though he had to actually learn the principles and practice of a new and intricate business, he mastered both and applied them well—in 1852 gas superintendents were not born; they had to be made. Deceased was also prominently identified with the present Lynn (Mass.) Gas and Electric Company, with which concern he became connected in 1875. In 1877 he was elected a Director thereof, and for several years his place thereon was virtually that of Managing Director. At the time of his death he was the oldest Director of the Lynn Company, both in respect of years and in point of service. He was also prominently identified with the affairs of the Somerville (Mass.) Electric Company, having served on its Directorate for several years. As may easily be understood, Mr. Neal's place in the gas industry of New England 30 years ago, which trading was then beginning to assume enormous proportions, was of sufficient importance to bring him in contact with those most prominent in its administration. Amongst his mentors he counted without fail upon the late Mr. W. W. Greenough, President of the old Boston Gas Light Company, and the writer of this history has often heard Mr. Neal speak of or tell about how much he owed to Mr. Greenough's advice. When the gas men who attended the funeral of Mr. James Barnard Blake (Mr. Blake was Mayor

AUG 10 1901 SMITHSONIAN DEPOSIT

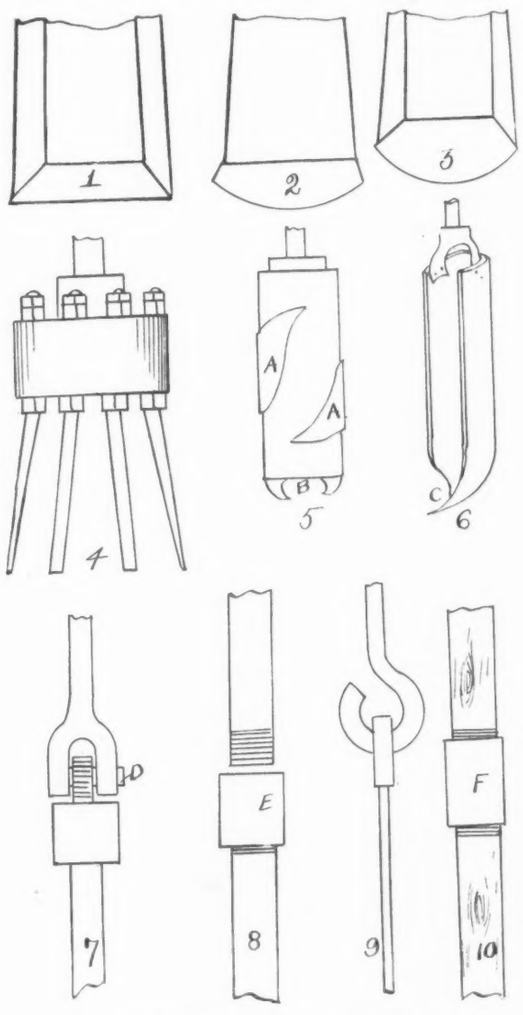
of Worcester and Superintendent of the Worcester Gas Light Company at the time of his death, which latter resulted from injuries received through an explosion in the purifying house of the Worcester Company the night of December 16, 1870) decided to found an association of gas engineers, Mr. Neal was prominent in the deliberations. When the organization of the New England Association of Gas Engineers was finally completed (Boston, Feb. 2, 1871), Mr. George B. Neal was chosen its Secretary and Treasurer, and served it as such until 1884. At the 1884 meeting he was elected a member of its Board of Directors, continuing thereon for four terms. No words of ours can fairly describe his zeal, faithfulness and success in building up the structure of the New England Association, but it does fall to us appropriately to say that his best thought and labor were always with it, and that to him no small measure of the Association's great success is due. Mr. Neal was also a member of the Guild of Gas Managers, which sterling body he joined at its December meeting, 1881. He was also an active member of the American Gas Light Association, his membership therein dating from the meeting held in Cleveland, O., May, 1874. As with the New England Association, Mr. Neal's voice and action and material aid were fully and usefully given to the American Association and to the Guild. While not a prolific writer of papers, some of his contributions to the records of the New England Association are well remembered. It is hardly within the scope of this memoir to recount the many other capacities in which Mr. Neal served his fellows and himself in the commercial world; but prominent in these we may note his Presidency of the Mutual Protective Fire Insurance Company, the Senior Vice-Presidency of the Five Cent Savings Bank, a Directorship in the Monument Bank, his Treasurership of the Ancient Charlestown Poors' Fund, and his Directorship in the Bunker Hill Monument Association. And in these administrations he was anything other than half-hearted or perfunctory. His connection with the local charitable good works of Charlestown were many and practical, and his was the hand that gave without waving, and unstintedly. The writer, in speaking of Mr. Neal's personal characteristics, does so in full knowledge of the man, our first meeting having been in the JOURNAL office in 1871. Never did facial appearance more belie a man than did the features of George Benjamin Neal. Square-jawed, solemn-browed and still-eyed, these were the merest sham masks that hid, but only for a moment, a kindly mind moved by as warm and true a heart as heart could be. In fact, his personality may thus be summed up: To look at him was to fear him; to know him was to respect and love him. The funeral services were held in St. John's Episcopal Church, Devens street, Charlestown, the afternoon of the 10th July. In its service, as was said in our brief notice of July 15th, "As member, organist, supporter, and finally Treasurer and Senior Warden, he labored faithfully and well for over two score years." The ceremonies were conducted by the Reverend Phillip Sprague, the Rector of St. John's, assisted by the Reverend George Maxwell. A junior male choir (whose instruction had often been given by deceased) sang the musical portion of the beautiful Episcopal service for the dead. The church was crowded to overflowing, and prominent in the mourning ranks were delegates from the New England Association of Gas Engineers, the Guild of Gas Managers and the American Gas Light Association. The floral tributes were many and beautiful, an especially notable one being the token from the New England Association. As an evidence of the temper of those who attended the services we repeat these lines received from one who was present at the sad, solemn scene: "After the services begun there occurred an incident, known hardly to half a dozen persons in the church, which, as a tribute of regard for the dead, in its simplicity and absolute freedom from ostentation, was not excelled by any other act. A laborer from the gas works appeared, clad as he left his labors. Approaching the outer door of the church, he uncovered and bowed his gray head. With slow, deliberate steps he proceeded to the inner door, and peered down the main aisle until he saw the casket. Instantly he bowed his head again, bent three times to and on his knees, the last time evidently being the prelude to a silent prayer. Taking a parting glance at the casket he softly withdrew, tears flowing freely down his furrowed face." For facts in connection with this history we wish to express our indebtedness to: Mr. Patrick Coyle, of the Charlestown Gas and Electric Company; Mr. N. W. Gifford, Secretary of the New England Association of Gas Engineers; Mr. Chas. F. Prichard, General Manager Lynn Gas and Electric Company; and Mr. A. B. Slater, Jr., of Providence, R. I.

DEATH OF COL. WILLIAM E. BARROWS.—Just as we go to press we have brief news reporting the sudden death of Col. William E. Barrows, President of the Welsbach Light Company, who passed away, at his home in Haverford, a suburb of Philadelphia, July 30th.

Boring for Natural Inflammable Gas, Oil, Etc.

[Prepared for the JOURNAL by "G. D. R."]

Since the extensive introduction of new and improved methods for boring for petroleum oil, many alterations have been made in the processes and appliances employed for boring for natural gas. Pennsylvania, New York, Ohio and other States have been unusually productive in natural gases in recent years, while the beds of sandstone and limestone of other States are at present offering a good field for operations. The familiar conditions under which gas, and frequently oil, are found include porous substances containing the gases, such as sands or rocks in which the gas may lodge, and a shale or surface covering to hold the gases from escaping. Sometimes a dome-like construction is encountered at the crown of which the gases are located. Often the eruptions to which the earthy compositions may have been subjected in the past are such that the tissues permit the escape of much of the gas. In whatever form the gas may be found, the boring processes for securing it are alike. The accompanying illustrations are presented to explain some of the tools employed. In Fig. 1 is shown the ordinary,



Boring Tools Used When Prospecting for Natural Gas.

square-pointed chisel which is often used for boring in sand, clay, soft rock, gravel, etc. This form of tool is fitted with guides to make it bore straight. The tool in Fig. 2 is provided with a rounded point, and is itself a guide. Fig. 3 is also self-guiding and is used for hard rock. In boring with these tools the solid earthy substances are gradually loosened and water is run in, reducing the powdered stuff to a pulpy mass that can be drawn to the surface through a suction pipe. In some cases dipping devices are employed and the refuse is scooped up. The pronged boring tool shown in Fig. 4 is used in some works. The cutting edges are fitted to project a little as shown, and quite a clean cutting results. The edges of the tools can be kept sharp by grinding. Another form of boring tool is shown in Fig. 5. There are two little cutters at *B* attached to the lower edge of this metal cylinder, and, in

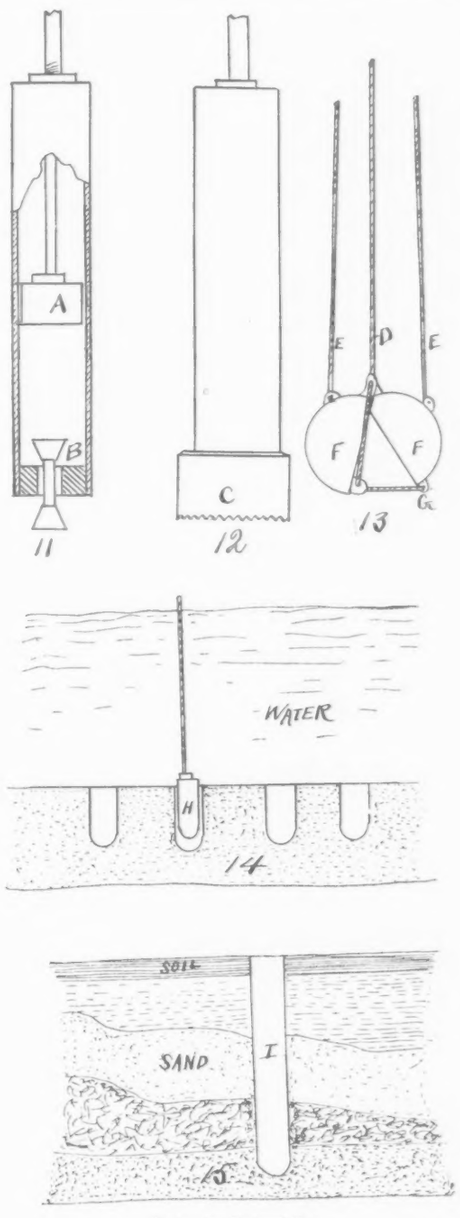
addition, there are blades *A*, *A*, attached. The pieces *B* start the earthy composition and draw some of it into the cylinder, from which it is scraped by devices lowered from the top. The blades *A*, *A*, both cut and clear in the passage. In Fig. 6 is another form of boring tool used in the gas and oil fields. It is half-cylinder in shape, and the nose is planned as shown at *C*. This tool is used for clay and soft deposits, and in instances where the earthy composition can be cut into readily.

The methods for boring for gas are the rotary system, in which the auger is revolved by rotation, and the percussion, by rods or ropes processes, in which the rods are caused to operate upon the cutting tools in such way as to effect the desired end. In sinking the tools for either the boring by rotation or by percussion, connecting links are required, and these are shown in the next set of illustrations. Fig. 7 shows the common form of joint used in lowering a boring tool to the depths of the boring. These rods may be from 10 to 15 feet long each, and the ends joined in various ways. In this case, the upper section is looped and fitted over the pin of the lower section, and a key *D* serves to make the union firm. In some cases one end is screwed into the other on the pipe plan, as shown in Fig. 8. The union piece is *E*, one end of which fits tightly over the pipe end, while the other can be put together by screwing and released by unscrewing as desired. Sometimes the hook system is used, but not very often. This style is shown in Fig. 9. When wooden rods are employed the joining of one end with the other is like that shown in Fig. 10. The union piece *F* is merely a section of pipe cut with a thread, and the wood rods are screwed into this union, and, to further add to the strength of the joint, pins are inserted through the union and the stubs of the wood poles.

For cleaning out the loosened substances in the bottom of a hole in process of drilling, several forms of applicances are used. Three types are shown in Figs. 11 to 13. In the first is shown an ordinary cylinder, which is made the same diamter as the hole, or a little smaller, and is usually about 5 feet long. There is a piston with a head *A*, and the cylinder is lowered into the hole by means of this piston rod. At the lower portion of the cylinder is an opening fitted with the valve *B*. As soon as the cylinder strikes the bottom, where the loose, muddy refuse is, the piston is first pushed clear into the cylinder and then gradually withdrawn. During the withdrawing operation the soft, muddy sands are sucked into the cylinder, and the cylinder can ordinarily be drawn to the top filled with excavations. After two or three trips, the loose stuff is all removed and the boring recommenced and the loose material again removed. At some of the wells the soft bottoms are cut out in disk-like pieces and removed by means of a device like that shown in Fig. 12. In this contrivance the cylinder is very like that of the device in Fig. 11. The lower part, however, is fitted with a saw-tooth head, *C*. The idea is to cause the teeth to saw through the clayey deposits and leave the disks of matter inside the cylinder. Several processes of work are essential to success in this undertaking.

It is seldom that the deposits are so soft as to permit the free cutting, and various means are used to aid in the progress of the tool through the strata. In some cases water is poured into the hole while the cylinder is revolved by mechanical devices above. As fast as the earth is softened by the water the sawing proceeds. The deposits may be reduced to a pulp inside the cylinder and drawn up by means of pumps and pipes; or the clay can be cut into until the cylinder is packed and then the cylinder drawn up and emptied. Clam diggers are used to remove the loose matter at times, and in Fig. 13 is shown one of these contrivances. Two half globes, made of sheet metal and hinged like *F F*, are used, and the lowering and hoisting ropes *E E* are connected as shown. When the device is at the bottom the rope *D* is drawn taut, and this causes the scoops to close up, for this rope passes through the rings to the lower part of one of the scoops at *G*. Usually, unless rocks interfere, the scoops bring up considerable matter, and it does not require much time to clear out the loosened stuffs.

Recently there has been some work done in the line of getting at the gas and oil deposits beneath water. The process of locating the deposits is varied. Sometimes shafts are sunk at considerable cost only to find that the returns are not rich enough to pay for the work. One of the simplest modes of ascertaining the character of the gas and petroleum deposits in soil beneath a body of water is shown in Fig. 14, in which a series of holes are drilled in the base sands. The gas and oil deposits, if they are present, will then rise to the surface of the water. Often explosive cylinders are used to break up the base. In this view *H* shows a cylinder containing explosive materials in process of being lowered by a rope into one of the drilled holes. Cylinders ready made for use may be purchased at dealers, and with each cylinder there is a complete printed account of how to insert and explode it. In sinking a shaft to reach gas or oil deposits, the hole may be bored to advantage, as shown in Fig. 15,



Foring for Natural Gas

at *I*. The upper crust is penetrated, and then often there are found mixed sands and earth with gravel, beneath which a strata of sand exists bearing the sought-for compositions.

Differential Rates for Gas.[1]

[A paper read by Herr W. von Oechelhaeuser at the Vienna Meeting of the German Association of Gas and Water Engineers.]

Once again recently has the question of differential rates for gas supplied for various uses been brought prominently to the attention of gas men by the reversion of some towns—of which Berlin is the most notable example of late—to a uniform price for gas, whether supplied for illuminating or other purposes. This uniform price is lower than that formerly charged for gas for lighting, but higher than that for gas for heating purposes. Moreover, in the *Journal für Gasbeleuchtung*, Herren Muchall and Merz, in separate communications, have lately advocated, not a uniform price for gas consumed for every purpose, throughout the year, as has been adopted at Berlin, Charlottenburg, Spandau and elsewhere, but one uniform price for the winter and another for the summer. Herr Borchardt has still more recently discussed the same matter. The whole question of the expediency of charging two distinct prices for one and the same description of gas, has therefore been raised anew.

1. Translated for the *Journal of Gas Lighting*.

The arguments which are brought forward in favor of a uniform price are so well known to gas men that it is unnecessary to occupy time with a recapitulation of them. The chief is that the necessity for the dupiication of services and meters is avoided when there is only one price for all the gas sold. Likewise the arguments brought forward, in the communications named above, in favor of a distinction between the summer and the winter price, need not be repeated. The author will rather endeavor in the present instance to expound his personal views, which are based on experience gained at the works of the German Continental Gas Company, and on observations of rate reforms in other towns. But before attempting this, he would again point out what has been so often demonstrated before—that the question of gas rates cannot be settled by reference to any general prescription. In no other matters connected with gas business are local conditions of so great significance. "Local conditions" is not used so much in the general sense of the term, as with reference to already existing conditions, whether these have been evolved from former rates or from established contracts between the municipalities and companies at the particular places. These conditions differ everywhere. Hence it is clear that, if at the present time gas lighting were being introduced in some place, the question of gas rates could be settled far more easily, and perhaps also more effectively, than in a case where the consumption has fallen into a particular groove in consequence of the existence for years past of differential rates. It must, therefore, be the author's task to proceed at first only in a negative manner, and to set forth plainly the considerations which, with most works, stand in opposition to any general adoption of a uniform price for the whole year. The author's chief misgiving is that the use of gas for technical purposes on a large scale—*i. e*, for gas engines, for heating irons in large works, and in the textile industry—will be considerably diminished, if not wholly stopped, by the adoption of the uniform rate for gas. And the misgiving extends, though in a lessened degree, towards the uniform rate with the additional provision of a different basis for the summer and the winter.

In the first place, it appears desirable to point out afresh the great importance to the gas industry of the consumption of gas by gas engines. For instance, taking for example, as a basis, a consumption of 2,650 to 2,800 cubic feet of gas for a private consumer's burner for lighting and for a cooking or heating burner, on the other hand a gas engine consumes for each horse power on the average over 35,000 cubic feet. Further, this consumption of gas for heating and power purposes, as is well known, not only occurs for the most part in the day time—though there is a certain amount of overlapping in the evening hours—but throughout the year. In most cases, moreover, it takes place in an almost ideally uniform manner, as has been pointed out by Herr F. Schäfer in recent writings. While in the *Journal für Gasbeleuchtung* it has been held that, as soon as electro-motors, with their extraordinarily great advantages, are available in small industries, gas engines must be relegated to the background, and be regarded as less economical, the author regrets that on this point he is of quite another opinion. He does not think it worth while to question the advantage of convenience, and the superiority in respect of small capital outlay for the installation, on the side of electro-motors; but, on the other hand, in by far the greatest number of cases the working charges are very much lower with gas engines of all sizes (but especially with those of 3 to 4-horse power) than with electro-motors. Thus, assuming that gas costs 38 cents per 1,000 cubic feet, and electric current 48 cents per kilowatt, the gas consumption costs less than half the consumption of current—both for a 12-horse power engine.

But regard must be had to the fact that with the electro-motor there is a smaller capital outlay to be redeemed. In the author's opinion, the greatest economy rests absolutely with the gas engine. This is the more true, because the relatively cheap working of the electro-motor is only achieved through electricians having from the outset, not only laid separate connections for the supply of current for technical purposes, but disposed of current for such purposes at a price which differs to a far greater extent from the price charged for current for lighting purposes than the prices of gas for the two uses differ from one another. The price of current for technical uses is, indeed, often so considerably below the cost of production, that in many towns the managers of the electricity works earnestly desire to have this uneconomical reduced price raised again.

While with the gas the difference between the prices charged for that sold for lighting and that sold for other purposes is, on the average, only 25 to 30 per cent., the similar difference in the prices at which electric current is sold averages about 66⅔ per cent.; or one price is more than double the other. Nevertheless, the cost of current consumed by a motor remains about double that of the gas consumed in a gas engine. Consequently, on the broad issue of economy (especially of economy to the community at large), it is clear that the gas engine is not inferior, but considerably superior, to the electro-motor. Only these towns are to be excepted from this generalization in which quite special conditions prevail for the production of electric current—as, for instance, those where extremely cheap water power reduces the cost of current to an exceptional extent. Consequently, if a uniform price of (say) 91 cents or 81 per 1,000 cubic feet for the whole year is introduced, while at the present time large consumers of gas for other than illuminating purposes obtain it at 70 cents or even 56 cents in some places, it is clearthat the introduction of the uniform price will deter the best friends which the gas industry has—viz., the owners of gas engines—from extending the use of this form of power. It will at least, having regard to the competition of electro-motors, render it very difficult to secure new installations of large gas engines. The same argument is also valid, though perhaps less forcibly, with reference to the proposal for one uniform price for the summer and another for the winter half year. It must not be supposed that, with a winter price of $1.06 or $1.12 per 1,000 cubic feet, there will be a considerable extension of the consumption by gas engines, provided the summer price amounts to 85 cents. Even this summer price is much too high for the consumption by large engines, etc.; while the winter prices named are about 40 per cent. above the customary price of gas for power purposes.

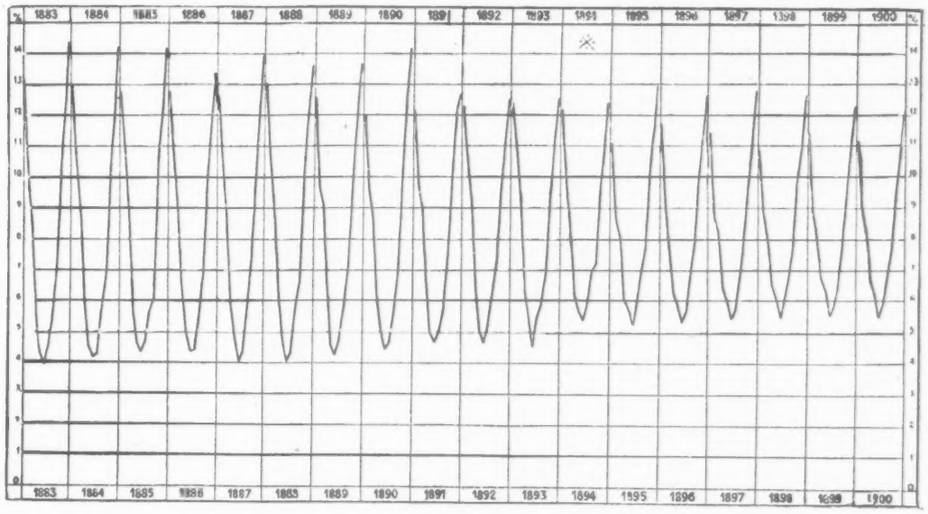
In addition to the two systems of rates for gas already named, there must also be mentioned a third which aims at securing the advantages of uniform prices for the winter half year and for the summer half year, while retaining the large consumers of gas for other than illuminating purposes. This system adopts the lower summer price for gas as the standard price for gas for power purposes in the winter also, in all cases where separate services and meters are provided. Thus there are in winter, as generally at present, two prices, but in the summer only one price for all gas sold. Nevertheless, this places the gas works also in the position to grant a rebate for large engines on the price of gas for power purposes, which is thus maintained uniform throughout the year, while not compelling them to go so far in this direction as electricity works go. The author holds the opinions already expressed by Herr Merz, of Cassel, against making a difference in price for gas each month, as the results achieved by this system have hitherto been in no way superior to those secured by the ordinary dual rate method, while a change of price each month entails more accountants' and clerical work.

The proposition, previously made by the author, that the uniform summer price should be applied to large technical consumers in the winter also, is confronted with many difficulties as soon as an attempt is made to apply it forthwith. This is illustrated by a circumstance in connection with the author's Company. Nearly all the managers of the works of the Company are in sympathy with the proposition in principle. Nevertheless, in particular instances, its immediate application has been prevented owing either to the terms of already existing contracts, or special conditions of sale. It has fared similarly at other works, when closely investigated. But the author's counsel would be the same with regard to every mode of fixing prices—*i. e.*, to aim foremost, by means of dual prices, at securing that the gas sales to consumers for engines and for large industrial uses shall not only be maintained, but even considerably augmented.

Reverting now to the main question, it is desirable to state what are the reasons which at the present time, after more than 30 years' experience, are in favor of the system of dual prices, and what are its underlying principles. While not desiring to speak *pro domo*, the author must point out that his Company claim the credit of having, in the year 1862, taken the lead with the introduction, at their works in Germany and abroad, of a reduction of about 25 per cent. on the price of gas sold for technical uses. Nevertheless, this clearly would not have prevented the Company, if they had experienced bad results from it, from reverting to a better system of rates for gas sold. Their experiences, however, have been so favorable that the author desires to call attention to them as shown in the diagrams annexed. In these, gas sold for lighting purposes is designated L Gas; that sold for technical uses in general, T Gas; that sold far heating purposes only, H Gas; and that sold for power purposes only, K Gas.

Diagram No, 1 shows the development of gas consumption in the town of Gotha, under the dual rate system. At the first glance, it is apparent that the fluctuation of the monthly outputs of gas has gradually become easier, as the crests and depressions of the curve have become shallower—more especially since the year 1894, when a lower summer price was introduced for gas used for technical purposes, but not for gas for lighting. But that a system of dual rates in force uniformly all through the year has a very decided effect in equalizing more and more the differ-

Diagram No. 1.—Gotha Gas Works. Percentage Distribution Among the Several Months, of the Output of Gas During the Years 1883 to 1900.



* Introduction of a lower summer price for gas used for heating and power purposes.

ences in the monthly consumptions during the year, is clearly and distinctly shown in Diagram No. 2. Figs. 1 and 2 in this diagram show the apportionment, in percentages, of the gas sold for lighting and that sold for technical purposes, so far as the latter was measured by separate meters, during the years 1883 and 1900. In the first place, it is to be remarked how uniform is the consumption of gas for technical purposes throughout each of the two years. It is not surprising that the uniformity of the consumption of gas for technical purposes is not quite perfect throughout the year, for the consumption of new customers that year makes itself felt by the autumn in an increase of the consumption for those purposes. But in the output of gas for lighting also there appears a small improvement between the years 1883 and 1900. This is to be traced to a large portion of the gas sold at the price of gas for lighting purposes having been applied for cooking and heating. The curve for lighting gas has thus also had very large differences between the months lessened for this reason; and the same annual output of gas has, in this manner been attained with a smaller gas plant, and therefore with a diminished capital charge.

The improvement, however, appears quite striking when the total output of gas of the Company for the year 1883 is compared with that for last year, as is done in Figs. 3 and 4, of Diagram No. 2. While in 1883 the maximum consumption (in December) is more than 4.8 times the minimum consumption (in June), in 1900 it had fallen to 2.7 times. This has been brought about without any special considerations being given to the winter and summer consumptions, but solely through a system of dual rates which makes the price of gas for technical purposes about one-third lower throughout the year. It must, further, be taken for granted that, if this system of dual rates be altered in the future, where contracts and local arrangements admit of it, by making a distinction between the summer and winter consumption, the equalizing of the gas consumption, and therewith the better utilization of the gas plant, will be effected far more rapidly than has hitherto been the case.

Diagram No. 1, giving a graphic delineation of the effect of the change at the Gotha gas works, affords a pertinent illustration on this point.

The distinction between winter and summer consumption will at once very greatly diminish the number of the inconvenient duplicated gas meters and services, and is, therefore, the author thinks, to be regarded as most important. A complete abolition of all duplicated services must be out out of consideration, because large gas engines could rarely be connected to an existing service for lighting purposes without alterations, as it would as a rule be too small for the larger consumption of the engine. The same argument applies also to large ironing works, kitchens, singeing apparatus, etc. But even if the service should happen to be sufficiently large, big consumers of gas for technical purposes would not be able or willing to forego duplicated meters, because they would otherwise lack convenient means of controlling their consumption for such purposes—for instance, for working gas engines. And it is constantly brought forward as an advantage possessed by the gas engine over the steam engine that its hourly consumption can be so distinctly checked, and that thus not only the efficiency of the system but also the condition of working of the engine at any time can be controlled. The author believes that the duplicated services and meters could not be wholly avoided, if only by reason of the means of control which they afford.

Since, for these reasons, the duplication of services and meters is not wholly avoidable, even with a uniform price for gas, and the whole question of new rates deals only with as great a diminution as possible in the number of such duplications, there should be presented on the other hand, on behalf of the dual system of rates, some statements which the author considers thoroughly refute the frequently expressed view that a lower rate for gas consumed for technical purposes constitutes an injustice towards consumers of gas for lighting purposes. For in any business transaction there are involved, as is well known, not only prices, but stipulations, on the one hand as to the magnitude of the quantity dealt with, and on the other hand as to the period and manner in which delivery is to take place. All gas engineers know that if they give a works an order for pipes or apparatus for the winter, they obtain them cheaper, with the same prices for raw material, than if, for instance, they order them in the spring. But no one has been able to descry injustice in a coal syndicate conceding lower prices for uniform monthly deliveries than for a sale which extends only to the winter months, or applies in an enhanced degree to them. It is also well known that for a long time spirit has been sold in the denatured (methylated) condition for industrial purposes—*i. e.*, for burning—more cheaply than the drinking spirit or spirits of wine, though the spirit, apart from the denaturing material, is the same for all purposes, and is produced in the same manner. State ordinances in this case create a great difference in price, which at the present time—if ordinary spirit is taken at 150 pf. and denatured spirit at 80 pf. per liter—amounts to about 80 per cent. But, further, the spirit ring have recently adopted the proper commercial principle of cheapening still further "motor" spirit. This is the cheaper by about 16 to 20 per cent. So that between spirit for motor purposes and ordinary non-denatured spirit, there exists a difference in price of 86 per cent.; while the extreme difference observed in gas prices is about 50 per cent.

The gas industry, which is carried on entirely from central points, and has to pay interest on an expensive distributing system, in addition to having the central stations, has more than any other to operate with might and main to bring about a better distribution of the year's output—just as electricity works are doing, almost without exception. And for this reason most works have hitherto rightly sold more cheaply for the consumption which induced a better distribution over the year. This action was based on quite correct commercial and economical principles.

Only because gas men know that by the wholesale employment of gas for technical purposes—apart from the special uses for heating in winter and for gas engines for electric lighting—a very much better distribution of output over the year is attained, do they adopt the system of dual rates.

According to the author's view, therefore, it is a mistake to demand that gas may be applicable indiscriminately for lighting or other purposes, and that it must be sold at one uniform price, simply be-

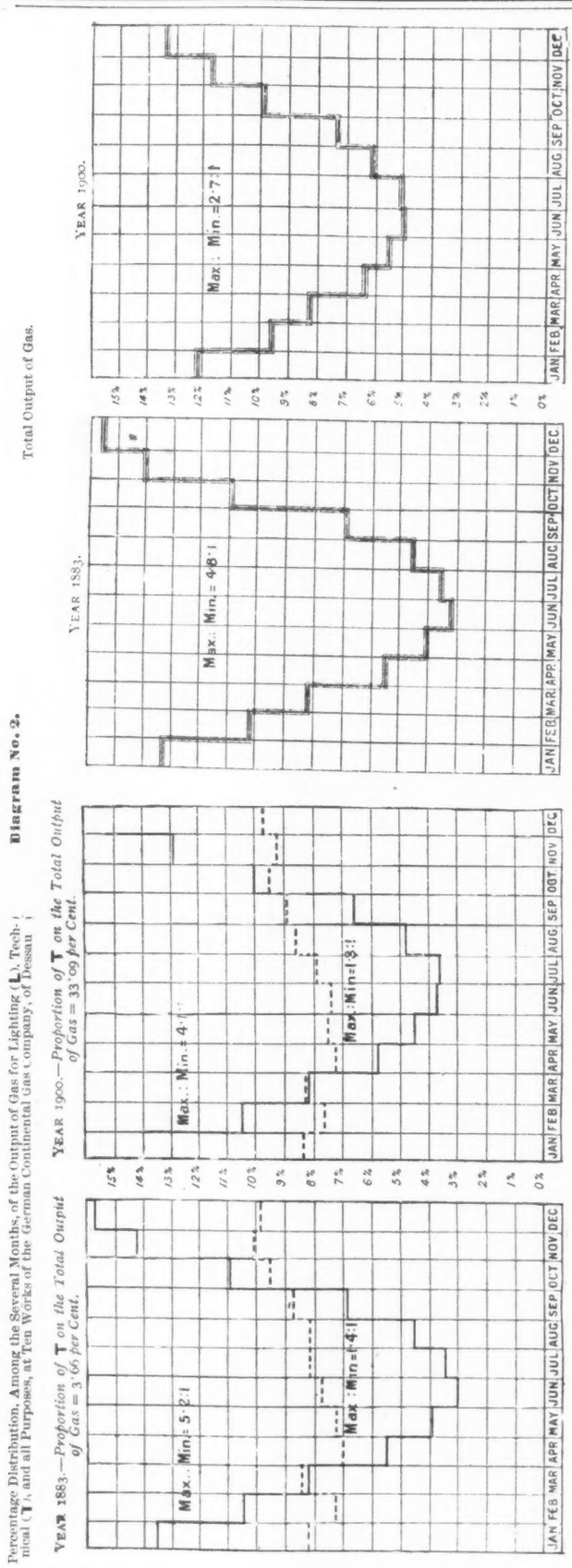


Diagram No. 2.
Percentage Distribution, Among the Several Months, of the Output of Gas for Lighting (L), Technical (T), and all Purposes, at Ten Works of the German Continental Gas Company, of Dessau
YEAR 1883.—Proportion of T on the Total Output of Gas = 3·66 per Cent.
Max.: Min.= 5·2:1
Max.: Min.= 4:1
YEAR 1900.—Proportion of T on the Total Output of Gas = 33·09 per Cent.
Max.: Min.= 4·1:1
Max.: Min.= 3:1
Total Output of Gas.
YEAR 1883.
Max.: Min.= 4·8:1
YEAR 1900.
Max.: Min.= 2·7:1
JAN. FEB. MAR. APR. MAY. JUN. JUL. AUG. SEP. OCT. NOV. DEC.
15% 14% 13% 12% 11% 10% 9% 8% 7% 6% 5% 4% 3% 2% 1% 0%

Fig. 1. Fig. 2. Fig. 3. Fig. 4.

cause the net cost of manufacture per 1,000 cubic feet, so far as wages and raw materials are concerned, is the same. The factor of apportionment of capital—nowhere to be ignored—is also certainly considerably higher in the case of gas which serves for lighting than of that used for other purposes.

[To be Continued.]

The Treatment of Waste Gases in Sulphate Manufacture.

According to the *Gas World* the annual reports of the Chief Inspector under the Alkali, etc., Works Regulation Acts always contain something more than dry statistics or the mere record of official duties performed. Occasionally there is some interesting story of industrial progress to chronicle. Thus, last year's report contained a historical retrospect of the value of coal gas residuals over a period of 50 years. And generally there is an account of some research or researches undertaken to throw light on difficult or not clearly understood technical problems which have been encountered in the discharge of official duties. It has, indeed, all along been a praiseworthy feature of the carrying out of the provisions of the Alkali Acts that the inspectors have not been content merely to see that the regulations were observed, and their infraction punished, but have labored to facilitate such observance, and been ever ready to advise and assist those charged with the conduct of the scheduled works.

The report of the Chief Inspector (Mr. R. Forbes Carpenter) for the year 1900, which has recently been issued, is largely taken up with the discussion of modes of treating waste gases from the manufacture of salts of ammonia, and with the constitution and analysis of ammoniacal liquors. In the working up of the ammoniacal liquor from the manufacture of gas, sulphuretted hydrogen is evolved, and, unless efficient means are taken for its absorption or retention, escapes to form a noxious ingredient of the atmosphere. There are, in different places, various methods successfully employed in dealing with this waste product, so as either to utilize it more or less profitably, or, at least, to prevent its becoming a nuisance to health. Of these, the method of burning the gas in the sulphur burners of a sulphuric acid plant is said to be the most economical and satisfactory; but, of course, its adoption is only possible where the manufacture of sulphuric acid is simultaneously carried on. In very few gas works, therefore, making sulphate of ammonia, can this method be adopted.

The Claus kiln, which allows of the conversion of the sulphuretted hydrogen into flowers of sulphur, while fairly satisfactory in some places, is not everywhere a success. Mr. Carpenter has the process under observation, and hopes to print, in next year's report, some remarks bearing on its adaptation to cases where, in its present form, it is not applicable. It is interesting in this connection to note the remark made by one of the district inspectors (Mr. Napier Sutton), that the chemical tests made to ascertain that the noxious gases SO_2 and SH_2 were not being discharged into the air "have been of real assistance in guiding the users to maintain a proper reaction in the kilns."

Oxide Purification: Necessary Precautions.—The method most generally employed for dealing with the sulphuretted hydrogen is that of its absorption by oxide of iron, as in ordinary gas purification. To work this method with safety and efficiency, Mr. Carpenter shows that there are several precautions to be observed. Most important of all, he insists upon the necessity for using only hydraulic valves for the connections to the purifiers. Very serious and fatal accidents have occurred through the non-observance of this precaution; and its importance cannot be too strongly emphasized. Where the lives of workmen are concerned, no unnecessary risks must be run; but every means of insuring safety which experience has justified should be unhesitatingly adopted. In this regard, the rules for filling and emptying purifiers observed at large works in District No. 6, and quoted in the report, may be commended.

Where oxide purification is adopted, Mr. Carpenter advocates that three purifiers should be employed; two to be standing at rest (or the material undergoing revivification) while one is working. This arrangement, he states, has been found to be economical as to labor—which it may well be, when we consider the slow rate at which revivification proceeds, compared with the rapidity of fouling in such situations. If allowed sufficient time, revivification of the fouled oxide may be effected *in situ*, without removal from the purifier. The advisability of protecting such purifiers by an open roof is emphasized; though it should be unnecessary in view of the well known fact that the efficiency of oxide for purification is much impaired by an excess of moisture.

New Methods.—A comparatively new method of dealing with the sulphuretted hydrogen is that of burning it to sulphurous acid, which latter is passed into towers packed with limestone, through which a stream of water is caused to flow. The sulphurous acid is neutralized by the limestone, and bisulphide of calcium formed, which flows away in solution, to the drains. This method has found favor in some situations because of the comparatively small ground space required and the absence of any solid residuals from the operation, or of much handling of materials. The principal drawbacks in connection with it seem to

be due, first, to the difficulty of insuring complete combustion, and, secondly, to the excessive wear and tear on the plant, due to the acid nature of the gases.

In a very few works the waste gases are conducted into the hydraulic main, whence they pass, with the general stream of gas, to be absorbed in the ordinary works purifiers. This method, while it may be of service in special situations, and in emergencies, is not one to be recommended for wider adoption. The increased cost of lime purification to remove the carbonic acid – or, otherwise, the serious loss in illuminating power, which must ensue – is sufficient to condemn the method as uneconomical.

Two new processes are mentioned as having been proposed during the year; though neither of them seems to have been actually employed on the full working scale. Both are based on the action of salts of iron in precipitating sulphur from sulphuretted hydrogen in aqueous solution; and both are, consciously or unconsciously, a recrudescence of old ideas. The first is an application of M'Dougall's invention, patented in 1899, for the purification of coal gas; and consists in passing the sulphuretted hydrogen gas through a solution of a ferric salt, preferably the sulphate, whereby the latter is reduced to the ferrous state, and sulphur is precipitated in the solution, whence it may be filtered out. So far the process is identical with that patented by Wallace and Christopher in 1878. They, however, proposed to re-oxidize the reduced iron solution by exposure to air; and this probably was the rock on which the process foundered, as the re-oxidation of the salt, in any completeness, is very difficult to accomplish, and we have never heard of the process receiving practical illustration. M'Dougall proposes to effect re-oxidation by electrolysis; and if he can accomplish this readily and economically, the process should be valuable for coal gas purification, as it would go a long way towards insuring that desirable consummation – complete purification in closed vessels. Mr. Carpenter remarks that the process has been tried with coal gas, "on a small working scale," and, "as regards removal of sulphuretted hydrogen, recent results obtained are promising."

In the second method referred to by Mr. Carpenter, ferrous sulphite is employed to bring about oxidation of the sulphuretted hydrogen, with precipitation of sulphur. Laboratory experiments have, however, been carried out, which show "that a material loss of sulphur takes place through formation of thiosulphate, the sulphur in which is lost as far as the process is concerned."

The Expert Report on the Carnegie Technical University.[1]

When Mr. Carnegie left to the trustees of the Carnegie Institute and the Carnegie Library the task of preparing a scheme for the technical school he proposes to endow at Pittsburg, he certainly unloaded a lot of hard work on that body. Nearly everyone who has been through a technical school of any kind or has employed graduates of such schools, thinks his ideas on the subject of technical education are a little in advance of those of any other man and far preferable to those of most people. Fortunately for all concerned, the trustees are men of affairs and understand the gentle art of making others do the delving while they attend to the reaping. So they first called to their aid a number of experts in technical education, Dr. Thurston, of Cornell, Prof. Johnson, of the University of Wisconsin, Prof. Gray, of the Rose Polytechnic Institute, and Prof. Anderson, of Armour Institute. These professors made individual reports which have, unfortunately, not been made public, because it would be interesting to learn how much of agreement there was in their views. The trustees were evidently somewhat nonplused by the result of their quest for advice, for they requested these experts to try to agree on some one plan. The latter recently succeeded in doing so by recommending a complete technical university, where the wants of the young girl who needs a little instruction in pie construction and hemstitching will be filled as completely as those of the erudite scientist who needs space, quiet and costly apparatus on a scale elsewhere unavailable in order to bring his important thoughts to fruition. The plan is comprehensive enough in respect to technical science and art to satisfy even the famous words of the founder of a great university, "I would found an institution where any person can find instruction in any study." It is accordingly interesting to examine in some detail the ambitious project these eminent professors have proposed for the dispersion of part of the Carnegie fortune. This is particularly true because they state that nothing short of such a complete system should be planned.

There are to be three distinct divisions of the school, according to this project, the technical college, the technical high-school and the artisan day and evening classes.

The technical college is to prepare graduates of high schools for leadership in commercial and industrial pursuits. To fit these youths the following grand equipment is proposed: "This college should be made attractive to the greatest scholars in the fields of physical and chemical science. To obtain and hold such men they must be given ample opportunities for research. This college must be supplied, therefore, not only with great experimental shops and laboratories for students' use, but in all departments there should be splendidly equipped laboratories of investigation and research, under the direction of the head of such department, and with a full corps of assistants for the carrying on of lines of investigation which are now partly or wholly unprovided for in America. These well-equipped workshops and these experimental and research laboratories would form the chief distinction of this technical college, and they would also be the chief item of expense. The college would support one or two publications in which the fruits of this research department would be given freely to the world."

It is frankly confessed in the expert report that this school will not have many scholars as compared with the technical high-school, but the work done in it would form "the chief, if not the only, feature of the whole scheme to attract attention and to extend its beneficent influences beyond the immediate vicinity of Pittsburg." A school without scholars is an impracticable sort of institution which has not yet succeeded in this country. It has been tried at Johns Hopkins University and at Clark University, both institutions designed to foster post-graduate investigations, but the results have not been such as to revolutionize science in any of its branches. If the purpose of the enormous expenditures contemplated in such a programme as that outlined is to advertise the City of Pittsburg as the home of "Culture," well and good. But the trustees of the Carnegie funds are men of far less acumen than they are commonly rated, if they can be persuaded that such a glorified technical school is needed to-day. Our great universities are the places for such research laboratories, for there scholarly calm and precision and self-effacement for the sake of lofty thought are inculcated. A technical school is a very different kind of institution, its very name implies something practical; its purpose is to educate young men to use time, money and the resources of nature to material advantage. The engineer must be quick and his thoughts must never get above the limit of practicability. Without in any way denying the great advantages of costly equipment for research, the *Engineering Record* has yet to be convinced that an enormous plant is necessary for teaching engineering. Moreover, as costly laboratories are not needed for the technical schools so much as for the university, just so advanced investigators in the various branches of science are similarly out of place, for they also belong to the university. A technical school is a technical school, and anything that tries to make it a rival of the university is to be deplored.

The second department of the proposed institution is a technical high school, drawing its pupils from the graduates of grammer school courses. The courses are to be largely elective. "In this school the boy who wishes to fit himself for industrial pursuits would find equal advantages with the boy who desired to prepare himself for professional engineering, or the girl who wished a general high school education supplemented by instruction in the home-making arts." Shops and experimental laboratories are proposed on a scale greater than anywhere now afforded in the country for the purpose, and the courses would be as follows: 1, The ordinary English high school studies. 2. Physics, chemistry and biology, with students' laboratory practice. 3, The elements of the calculus and applied mechanics. 4, French, German and Spanish. 5, Commercial studies. 6, Domestic arts and sciences. 7, Freehand and mechanical drawing. 8, Technical studies fitting for the industries of the locality, such as blast-furnace and foundry practice, glass making, brass founding and finishing, pattern making and joinery, metal working, engine and boiler management, power-station management, gas making, railway transportation, plumbing and domestic sanitation, surveying, clay working and ceramics, industrial art.

The third branch of the school comprises day and evening classes in elementary mechanics, mathematics, physics and chemistry, freehand and mechanical drawing, modern languages and elementary instruction in such technical subjects as are taught in the technical high-school, supplemented by courses of lectures on subjects of interest to artisan classes.

With all deference to the eminent professors who have proposed this tri-party institution, it must be acknowledged that to those who ar-

1. *Engineering Record.*

hoping to see the Carnegie school become a great power in the land the project seems very insipid. With the example of the Cooper Union in New York, turning away every year about two thousand young people for whom it cannot provide, a project for an industrial school which can offer nothing better as its leading attraction than enormous laboratories and a score of deeply-learned specialists is not the last word on the subject by any manner of means. Now that the trustees have received the pedagogical report, it would be a very good thing to get one from an equal number of men who, beginning life as water boys, time-keepers and printers' devils, have won success by unaided native ability. It would be worth the time to hear from these captains of industry and of engineering, who have not been through technical schools, for they may very likely be able to point out a few things which are overlooked in the present ready-made scheme of education.

There are many foremen for every engineer and there are many artisans for every foreman. When all is said, it is the artisan's instruction which should be considered first, then that of the foreman, and finally that of the engineer, for the last needs the least attention just now. Years ago Peter Cooper, himself familiar with the trials and hardships of the laborer's life, determined that the best use to which he could put his fortune was the education of laboring men, not only in the scientific principles underlying their work but also in the elementary facts of law and of civil government, so that they would become better workmen, better citizens and able to secure enjoyment from a wider range of subjects. The institution which bears his name and has steadily carried out his ideas with remarkable success has not been regarded with uniform favor by teachers of technical subjects, possibly because its fundamental idea was the good of the pupil and not the advancement of the scientific reputation of the instructors. Nevertheless it has been a grand success. It was the recognition by this great philanthropist of the real needs of the workman, just as it was a like recognition of the same needs by the correspondence schools, that caused their unparalleled success. So before the Carnegie trustees adopt any recommendations for great schools, it will be highly desirable for them to decide whether they wish to provide for the citizens of Pittsburg educational advantages now beyond their means or to provide a place where a select few can carry on recondite advanced study. The question simmers down really to this choice, because the project for the technical college, stripped of its distintive feature of advanced work, is merely a plan for another technical school of the familiar type. The *Engineering Record* sincerely hopes that the choice, when it is made, will be to the advantage of the workers in the industrial establishments of the city where the Carnegie fortune was made, for while they may not add quite so much to pure science possibly their better education will redound more to the welfare of the municipality and to the fame of the man who places his wealth at the trustees' disposal for such a noble aim.

Oil as a Fuel.

By Mr. Wm. Kennedy, C.E., in *Southern Industrial and Lumber Review.*

Since the first producing oil well was bored in the Beaumont region we have heard every day the great fuel question discussed and the broad assertions made that the petroleum supply in that region was exhaustless, that it solved the fuel question and a great number of similar claims made for the oil. The wildest kind of assertions have also been made as to the saving in cost it would make to all users of fuel for steam or other purposes, no matter where located or how situated with reference to the fuel supplies contiguous to the locality in which the proposed user may find himself. Reference is made to the immense saving arising from the use of the petroleum refuse in the Russian railroads and steamers navigating the Caspian sea and the inland seas and rivers in Southern Russia generally.

In all these assertions and calculations one very important element is left out and that is the question of location of the fuel supplies and the initial cost of these at their point of origin. That is to say with an unlimited supply of oil close to the point of usage and a very limited quantity of coal and that requiring a long haul involving heavy cost of transportation their oil would not only be preferable but much cheaper and the changing from one to the other would show a very large reduction in the initial cost of fuel in favor of oil. On the other hand if we reverse the case the use of petroleum in any form would practically be prohibited.

The first condition is that of Southern Russia. There they have large supplies of petroleum at a low cost whereas coal is scarce and difficult to get and consequently high priced and expensive. In that region it is therefore not only a matter of economy to use petroleum but largely a matter of necessity as well.

Coming nearer home, however, can we say that fuel oil is displacing coal in any of our great coal producing centers?

Ever since the introduction of oil as fuel we have heard the story of that material displacing coal in the manufacturing world and the same story was set afloat and maintained when the factories of the country began the use of natural gas. So far as can be learned from the published statistics of these two products from a fuel point of view it looks as if coal although probably displaced to some extent still continues to hold its own and in point of fact instead of there being any material reduction in the output the country as a whole or even as distributed by the several coal producing States shows an enormous increase in coal production. Natural gas on the other hand not only does not show an increase in production but a material decline all along the line. The year 1888 appears to have been the year of maximum output but since then gas has shown an annual reduction. Petroleum on the other hand has shown a steady increase in the production of crude from 21,847,905 barrels in 1885 to 45,822,672 barrels in 1890 and 52,011,005 in the census year 1899. Owing probably to improved methods of refining and the introduction of other methods of producing fuels in the gaseous form the production of fuel oil has fallen from 12,392,520 barrels in 1889 to less than half or 6,095,224 barrels in 1899, a fact worth considering in connection with our Texas oil supply. Nor does it appear to have enhanced. It 1889 this class of oil was worth 16¾ cents per barrel and in 1899 only 13 cents per barrel.

The actual value of the Texas petroleum as a fuel oil we have no direct means of knowing for the present. There appears to have been only two analyses published and these very widely. Indeed so much so that it is difficult to say which one may be correct and if we take both to be exact or even nearly so then we are forced to assume an anomalous condition in the constitution of the oil. It appears both samples came from the same well, but while it may be stated with considerable positiveness that no two pretroleums from different localities are alike in composition yet it is hardly possible that two samples from the same well will show such wide variations in composition as that we published as being analysis of the Beaumont petroleum.

Unfortunately no ultimate analysis of the Beaumont oil has been published and we therefore are unable to calculate the theoretical value of this product for comparison with the petroleum of other fields and thus be enabled to arrive at some definite knowledge as to its actual worth and so be in a position to see to what extent it may or can replace coal as a fuel in Texas and the general Southwest where coal is, to say the least, not a very plentiful commodity.

According to Mr. Urquhart, locomotive superintendent of a Russian railway using using petroleum refuse altogether, the calculated evaporation of this refuse as compared with good English coal is 17.1 pounds of water in 1 pound of petroleum as against 12.16 pounds to 1 of coal when used at a pressure of 126 pounds. From 212° F. the values are, for oil 30.53 and water 14.61. While the heat units shown for oil are 10,832 and for coal 14,112. The Pennsylvania heavy crude oil has a heating power of 20,736 and the Caucasian heavy crude 30,138 units.

These figures agree pretty nearly with the generally accepted theory that petroleum has a heat energy of practically 50 per cent. greater than coal.

Now, then, if we assume the Beaumont petroleum to be of average quality, that is to say, its energy is 50 per cent. greater than the average coal, we can arrive at a somewhat approximate value of the saving to be effected by its use in energy at least. A barrel of petroleum in commerce is 42 gallons, weighing 6½ pounds per gallon. A barrel thus exclusive of barrel weighs 273 pounds or 7.33 barrels to a ton of 2,000 pounds. Now as petroleum has 50 per cent. more energy than coal it is clear twice as much coal will be required to generate the same quantity of heat, or conversely 3.66 barrels of this oil will give the equivalent heat energy of a ton of coal.

Few of the bituminous coals brought into Texas exceed 7,500 heat units or about half the assumed energy of the coal used in the above calculations; consequently the oil will have a much higher relative energy and a much smaller quantity will be necessary, and when compared with our lignites the value of petroleum will be about three times as great, or in the ratio of 20,860 heat units for petroleum to 6,289 heat units in lignite.

The monetary value of these differences will, of course, depend upon the location at which it is proposed to use the fuel, and can readily be calculated by any one interested. Given the rate of transportation and

cost of coal in their vicinity then the matter resolves itself into a very simple calculation.

The early methods of utilizing the crude petroleum were simple and in fact the original method is largely adhered to at the present day. This consists simply of forcing the oil through a pipe and spraying the same in the fire box by a jet of steam or air. The spray of fire is broken up by a bridge of firebrick and so scattered that the flame comes into contact with every portion of the heating surface. It has been found necessary in many cases to protect the boiler plates and tubes by a casing of firebrick owing to the intense heat generated by the burning oil and gases arising from the decomposed steam. Much has been said against this mode of firing on account of the greater number of repairs necessary, but Mr. Urquhart claims that during the 10 years in which he had been using the refuse oil as fuel that repairs had fallen off nearly 40 per cent.

Another method of utilizing petroleum is by first reducing it to a gas. It is asserted by gas producer men and others that by this method the oil can be made to give a greater efficiency than 82 per cent. and be used in a great many other positions than the crude material, as by its reduction the contained sulphur and other impurities are entirely eliminated. The value of this will be better understood when we know that fuel containing over 1 per cent. of sulphur is unsuited for iron manufacturing purposes. It must be borne in mind that when the oil is sprayed into the fire box by either steam or dry air as is the conditions of firing in stationary or locomotive firing it does not enter in the form of gas but simply as a very finely divided oil, and as such contains all its natural impurities which otherwise cannot be eliminated by filtering or use of fine wire screens. For stationary work the oil might be reduced to the gaseous form, but that would be impracticable in locomotive work, nor is it either desirable or necessary.

In metallurgical work where the fuel is of necessity required to be as free from sulphur and several other impurities as possible the reduction of the oil to a gas is required. Under these conditions it can be used effectively in the manufacture of wrought iron and steel; in the open hearth process of steel making gas is considered a prime necessity. Gas also is effectively used in glass making, in rolling mills and in the roasting, drying and smelting the ores of gold, silver, copper and several others with economy.

In its gaseous form, however, petroleum has to come into competition with the various forms of fuel gases now on the market, and particularly those made by the various classes of producers now on the market using not only oil, but coal, wood, peat and almost everything containing a sufficient amount of carbon to make the gas. Water gas and the producer gases can at present be made remarkably cheap, and although these have not a particularly high heating power, yet the economical manner in which they can be made enables them to compete with most of the higher priced gases containing a greater heat unit.

No tests of the Beaumont oil have been made, or if made, available for comparison with the other gases now in use. The only statistics available regarding the Texas fuels are confined to the lignites-Laredo coal and Corsicana oil. According to Mr. Miller the lignites gave from 2.50 to 2.75 cubic feet of gas of 14 or 15-candle power per pound. Laredo coal but 3 feet of 22-candle power gas per pound and the Corsicana oil 5.50 to 5.75 feet of 32-candle power gas per gallon. This shows that at least as a gas producer the Corsicana oil far exceeds the lignites.

It must be conceded, however, that the Corsicana oil is much superior to the Beaumont oil in many respects, and until the Beaumont producers are willing to give some demonstrations as to the fitness of their oil for the several uses for which oil is required, they can hardly blame consumers if they give the Corsicana field the preference. This ought to be done as apparently there is a much larger quantity at Beaumont than Corsicana, and the actual usefulness of this oil is a knowledge greatly to be desired.

The Oxidation of Nitrogen as a Source of Error in the Estimation of Hydrogen and Methane.[1]

By Mr. Alfred H. White.

The author had occasion some time ago to estimate accurately a small amount of methane mixed with a large amount of hydrogen. A sample mixed with air was exploded in a Hempel pipette with due precautions to insure accuracy, the measurements being made in the author's burette for exact gas analysis previously described in this journal. Though great care was taken in the work, the results were so discrepant as to be entirely useless for the purpose. The results of a series of five experiments follow, arranged in the order of explosive ratios.

1. *Journal American Chemical Society.*

Table I.—*Explosion of Hydrogen and a Small Amount of Methane.*

Gas Sample. cc.	Air. cc.	After Explosion. Contraction. cc.	After Explosion. CO_2. cc.	Hydrogen. Per Cent.	Methane. Per Cent.	Explosive ratio.
12.87	103.24	16.97	0.05	87.64	0.39	5.77
13.79	86.89	18.39	0.04	88.51	0.29	5.08
13.17	84.18	17.56	0.06	88.27	0.45	4.54
14.77	87.23	19.66	0.09	87.92	0.62	4.20
18.38	87.03	24.48	0.16	87.62	0.87	3.30

The increasing amounts of carbon dioxide cannot be laid to diffusion through the potassium hydroxide used, for the pipette carried enough mercury in the bottom to form a trap, nor to solution of gas by the potassium hydroxide, for the pipette had been carefully saturated by a blank experiment, nor to leak in connections because in each case after removing the carbon dioxide by potassium hydroxide, and reading the volume, the gas was passed back into the same potassium hydroxide pipette, allowed to stand and again draw back into the burette and the volume read. In only one case, the third given, did the variation in volume after such second treatment with potasssum hydroxide amount to as much as 0.02 cc. In two other cases, the variation was 0.01 cc. and in the other two there was no change in volume. Leaving out of account the first of the series where it is probable the great dilution caused incomplete combustion, the other four results show increasing methane and decreasing hydrogen as the explosive ratio (ratio of the inert to the exploding gas) grows smaller. The decrease in the percentage of hydrogen results from the method of calculation, all the contraction over potassium hydroxide being considered as carbon dioxide, and calculated to methane. The increase in the apparent carbon dioxide points strongly to the formation of oxides of nitrogen. That these are formed and may cause error in explosion analyses was shown long ago by Bunsen, who experimentally determined certain limits within which there was no appreciable error. The explosive ratio for pure hydrogen, according to Bunsen, might safely vary from 3.81 to 1.55. He did not determine whether any gases absorbable in potassium hydroxide were formed in the explosion. The results above cited have, with one exception, higher explosive ratios than his highest, and yet there is apparently considerable formation of an oxide of nitrogen which is absorbed by potassium hydroxide.

Bunsen's results have been seemingly everywhere accepted without question. Hempel, in the 1900 edition of his "Gasometrische Methoden," quotes Bunsen's results with the comment that "by keeping to the Bunsen form the worst that may happen is that the mixture is not explosive. The combustion of nitrogen will certainly be avoided."

The marked disagreement of the results given by Bunsen and those of Table I. made it desirable to make a series of experiments on pure hydrogen. The hydrogen was generated by the action of potassium hydroxide on aluminum in order to obtain it free from the small amounts of hydrocarbons usually present in gas obtained by the action of an acid on a metal. The results are given in Table II.

Table II.—*Explosion of Pure Hydrogen.*

Sample hydrogen cc.	Air. cc.	Contraction after explosion	Hydrogen Per cent.	Contraction over potassium hydroxide.	Explosive ratio.	Bunsen's results recalculated. Explosive ratio.	Bunsen's results recalculated. Hydrogen. Per cent.
11.35	84.80	16.90	99.26	0.00	4.64	3.81	99.92
12.11	85.57	18.08	99.53	0.00	4.37	2.90	99.56
14.19	84.27	21.27	99.92	0.00	3.62	2.29	99.84
16.77	85.77	25.13	99.90	0.01	3.06	1.95	100.04
16.54	82.64	24.76	99.80	0.01	3.00	1.55	100.15
18.19	83.22	27.29	100.01	0.01	2.71	1.25	100.72
21.10	83.28	31.74	100.28	0.00	2.29	1.04	103.14
27.04	83.86	40.80	100.59	0.11	1.73	0.37	105.06

Bunsen's results recalculated to permit direct comparison are appended. Bunsen held that the explosive ratio might vary from 3.81 to 1.55 without causing appreciable error, though the smaller ratio gives erroneous results according to his own figures.

These figures for the explosion of pure hydrogen in Table II. do not show as great variations with change of explosive ratio as do the results in Table I. of explosion of a gas carrying a small amount of methane mixed with a large amount of hydrogen. To determine if the methane caused the difference, a series of explosions of methane and air were made. The methane was made from methyl iodide and the zinc copper couple, and both gas and air were freed from carbon dioxide before use. Table III. gives the results of this series.

Table III.—*Explosion of Methane.*

Sample methane. cc.	Air. cc.	Contraction after explosion.	Carbon dioxide cc.	Methane Per cent.	Hydrogen Per cent.	Explosive ratio.	Ratio contraction sample.
7.05	92.07	13.09	6.53	92.62	0.28	4.05	1.85
8.93	104.17	16.66	8.31	93.28	0.14	3.53	1.86
9.07	98.35	17.10	8.54	94.15	0.14	3.19	1.88
10.20	98.22	19.27	9.63	94.41	0.06	2.61	1.89

In these experiments the explosive ratios all lie within Bunsen's limits for methane of 4-2.7: still there is a variation of 1.6 per cent. in the apparent percentage of methane as calculated by the usual methods and a corresponding variation in the amount of hydrogen. The precautions mentioned before were taken to prevent error from diffusion or solution in the potassium hydroxide pipette. In all these experiments the gases had been diluted with air and the preponderating inert gas was nitrogen. Several experiments were made with mixtures of hydrogen and methane to determine whether any more trustworthy results might be obtained, using oxygen alone in excess. The oxygen gas used was 96.5 per cent. pure. The results showed that the errors when using oxygen thus were rather greater than when using air in similar amount. In several cases, both when using oxygen and air, Griess' reagent for nitrites (napthylamine hydrochloride and sulphanilic acid) was introduced into the pipette before explosion, with the result that a deep red color was always formed after explosion, proving the formation of nitrous acid.

The explanation of the discrepancies between the author's work and Bunsen's is probably to be sought for in the different forms of apparatus employed. Bunsen used a narrow eudiometer in which the propagation of the explosion and liberation of heat would be slower and the absorption of heat by the glass walls more rapid than in the nearly spherical Hempel pipette; hence the temperature of combustion would be less in Bunsen's work and there would be a smaller amount of oxides of nitrogen formed. In Bunsen's eudiometer also explosion took place under diminished pressure, while in the Hempel apparatus a considerable plus pressure was generated in the explosion. It follows that when working with the Hempel apparatus a greater amount of inert gas than Bunsen found necessary should be present. Apparently the most nearly correct results are obtained in the case of hydrogen when the ratio of the non-explosive to the explosive gases follows Bunsen's higher figure: *i. e.*, when the explosive ratio varies from 4 to 3. In no case will absolutely correct results be obtained, as probably in all cases of explosion under these conditions nitrogen is oxidized to some extent. In the case of methane the higher temperature of combustion causes greater errors and here also the higher explosive ratio given by Bunsen should be adhered to.

The method of Dennis and Hopkins, in which the gas in contact with a glowing platinum spiral burns quietly in a current of oxygen and air, allows the use of a larger sample. It is, moreover, indorsed by Hempel in the following words:[1] "The advantage gained is that in the beginning, where the combustion might become too intense, there is always an excess of combustible gas, so that on the one hand no explosion can take place, and on the other none of the nitrogen can burn, as the combustion takes place at the beginning with an insufficient amount of oxygen, and towards the end when the combustion becomes complete, such high temperatures as are necessary for the combustion of nitrogen are not reached at all."

Some preliminary experiments having shown that it was by no means so certain that nitrogen might not burn under these conditions, tests were made on air with Greiss' reagent for nitrites in the pipette, when it was found that a test for nitrites quickly developed after heating the wire. Table IV. shows quantitatively the effect on the volume of air when the spiral is heated to redness. The air was freed from carbon dioxide and the samples were as nearly as might be 80 cc. each. While it was not possible to measure accurately the temperature of the wire, a comparison could be obtained by measuring the current heating it. A current of 4 amperes heated the wire to barely visible redness in the daylight and 5.35 amperes heated it to a white heat. The time was in each case two minutes.

TABLE IV.—*Effect of Heating Platinum Spiral in Air.*

Sample Air. cc.	Current Amperes.	Contraction after heating. cc.	Contraction after Potassium Hydroxide. cc.	Total Contraction. cc.
80.90	4.0	0.01	0.00	0.01
82.51	4.55	0.04	0.02	0.06
80.99	4.6	0.03	0.03	0.06
81.22	4.65	0.04	0.01	0.05
81.70	4.8	0.04	0.10	0.14
81.88	5.0	0.11	0.10	0.21
83.10	5.1	0.08	0.17	0.25
80.49	5.3	0.06	0.18	0.24
80.67	5.35	0.12	0.18	0.30

It will be observed that the sum of the contraction after heating and after potassium hydroxide given in the last column increases quite regularly with increase in temperature, but that there is considerable irregularity in the ratios between the contraction after heating and the contraction after potassium hydroxide. It may be that the more or less complete condensation of the nitric acid formed, depending upon time, contact, and the amount of water present, is sufficient to account for it.

To afford a direct comparison between the explosion and combustion method, hydrogen generated from aluminum and caustic potash was stored in a gasholder containing mercury and a little dilute caustic potash. The hydrogen was supposed to be pure but evidently contained a little air. The oxygen used was about 97 per cent. pure.

TABLE V.—*Comparison of Explosion and Combustion Methods on Hydrogen.*

Explosions with Air.

Sample Hydrogen. cc.	Air. cc.	Contraction After Explosion. cc.	Contraction Over Potassium Hydroxide. cc.	Hydrogen Per Cent.	Explosive Ratio.
15.32	85.34	22.71	0.04	98.82	3.43
18.15	82.39	26.93	0.06	98.91	2.73

Explosions with Oxygen.

	Oxygen.				
14.82	93.51	22.04	0.02	99.14	3.91
16.48	82.18	24.51	0.02	99.15	3.02
20.58	80.09	30.60	0.03	99.12	2.29

Combustions by the Dennis and Hopkins Method.

	Oxygen.	Air.				Oxygen in Excess.
91.29	51.65	54.55	136.72	0.04	99.84	13.72
58.48	53.39	50.14	87.43	0.10	99.66	40.89
89.31	40.77	50.21	133.57	0.07	99.70	3.73

The results of the explosions with oxygen are slightly higher than those with air, show very little contraction over potassium hydroxide, and remarkably little variation with change in explosive ratio. The results with the Dennis and Hopkins method are about 0.6 per cent. higher than those obtained by explosion with oxygen. The variations in the individual results by this method may easily be accounted for by the intentional variation in the proportions of nitrogen and oxygen used, and the unavoidable differences in temperature of spiral and time of heating.

The question naturally arises, which of these methods is more reliable. That none of them are entirely correct is certain, for if nitrogen of the air is oxidized to an appreciable extent by a platinum spiral heated to dull redness, oxides of nitrogen must be formed in all combustions. This has been shown by Ilosvay[1] for flames, even when the temperature of combustion was much reduced by dilution of the gas with carbon dioxide. The same author also found a slight formation of nitrous acid in the case of air burning in an atmosphere of illuminating gas, where a reducing atmosphere would always be present.

Summary.—Oxides of nitrogen are always formed in explosion analysis in amount increasing with the violence of the explosion. The dilution recommended by Bunsen, when exploding in eudiometer tubes under reduced pressure, is not sufficient when working with the Hempel explosion pipette. If the explosive ratio is kept between four and three, the error is negligible in the technical analysis of gases almost entirely hydrogen. The presence of small amounts of methane increases the error, and if large amounts of methane are present, the error may easily amount to a per cent. or more. The explosive ratio should be kept between four and three as in the case of hydrogen. The method of Dennis and Hopkins tends to give high results, and the errors may easily become of importance if care is not taken to avoid heating the spiral too hot and too long. Neither the explosion method nor any method involving active combustion can give strictly accurate results.

1. "Gasometrische Methoden," 3te Aufl., p. 123-124.

Petroleum—Something of Its History.

By Mr. JAMES W. DRAPE, in *Stowell's Petroleum Reporter.*

The origin of petroleum is involved in greater obscurity than that of coal. Some maintain that it is a substance of organic origin, while many (notably a school of French chemists) advance arguments in favor of a mineral basis. Petroleum is from petra, a rock, oleum, oil, or rock oil. From time immemorial, petroleum or rock oil, has been known. We find in the antediluvian world such references as these: "And he made him to suck honey out of the rock and oil out of the flinty rock." "And the rock poured me out rivers of oil," etc. We find it to have been known in Babylon. Alexander, Trajan and Julian gave attention to

1. *Bull. Soc, Chim.*, 11, 737 (1889).

The ruins of Nineveh gave evidence of the existence of petroleum. It was found on the shores of the Dead Sea 1700 B. C. The Egyptians recognized its value. It was known in Northern Italy in 1640. In the vicinity of the Caspian sea, the Bakoo springs have yielded large quantities of oil. Some of the Persian wells have yielded 1,500 barrels a day. On one of the Ionian islands there was an old fountain that flowed over 2,000 years. In the West Indies, as well as in several places in Central and South America, petroleum has been found. It was found in small quantities around Vesuvius, also near to Edinburgh, the capital of bonnie Scotland; and John Chinaman (who is a patient fellow, and seldom fails) perforated the earth to a depth of from 1,500 to 2,000 feet, when oil responded to his efforts.

On the 3d of September, 1700, the Earl of Bellomont, Governor of the Province of New York, issued instructions to Colonel Romer, his majesty's chief engineer in America, to examine the territory in Seneca county as to the foundation for certain reports of the appearance of oil, and discovered the article creeping out from between the rocks, which blazed up in a flame when a light was put to it. Charlevoix, in his description of the Genessee river, in 1721, says that oil was discovered in that valley by an officer named Ganos, who said that the savages make use of it to appease all manner of pains.

In Sir William Johnson's Journal of Indian Transactions at Niagara, in the year 1767, he writes, "Asueshan came in with a quantity of curious oil, taken off the top of the water of some small creeks in the neighborhood." In Kalm's Travels in North America, published in London in 1722, is a map upon which there is a point on the Allegheny river, about eight or ten miles above French creek, designated by a cross, and marked "Petroleum." In a letter dated Pittsburg, September 16, 1779, giving an account of Colonel Broadhead's expedition against the Senecas, in August and September of the same year, the writer says, "Upon our return we crossed a creek about ten miles above Venango, remarkable for an oily liquid which oozes from the sides and bottom of the channel, much resembling British oil." In a letter from General William Irvine, to his excellency, John Dickinson, dated Carlisle, August 17, 1785, he writes, "Oil Creek has taken its name from an oil, or bituminous matter, which was found floating on the surface. Many cures are attributed to this oil by the natives, and lately by some whites, particularly rheumatic pains and old ulcers."

The existence of oil in the valley of Oil creek, in Venango county, has been known for a long period. The Indians, from time immemorial, resorted to the valley at stated seasons to gather the oil for medicinal purposes. There are evidences, we are told, of the probable use of the oil by a race prior to the Indians of our own period. An article in the *Massachusetts Magazine* for July, 1791, describes the oil springs in what was then called Oil creek, and says that the American troops, in their marching that way, halted at the springs, collected the oil and bathed their joints with it, which gave them immediate relief from the rheumatic complaints with which many of them were afflicted. The first oil company of which we have any knowledge existed in Venango county, nearly a century ago. Two jolly neighbors procured a few barrels of oil then called "Seneca Oil" on Oil creek, and procuring a horse and wagon, gathered up what small bottles and vials they could, and started East, vending the oil as a medictne. On nearing a town the funny old man of the twain would go ahead and stop at the taverns, and taking a drink of brandy would sit down to rest, but would soon be rolling on the floor of the barroom in great distress. At this juncture the portly partner—a doctor—would stop in, saying, "What ails the old man?" but none could answer, and after feeling the pulse the doctor would explain, "Gentlemen, I have in my wagon at the door a medicine that will cure the stranger in ten minutes." Whereupon a dose of "Seneca Oil" was administered and relief given instantly; and every man wanted a bottle, no matter at what cost. A pretty good "Yankee dodge."

The Seneca Indians caught the oil fever, and primitive though they were, also caught the oil, throwing their huge blankets over the creeks and eddies of the upper Allegheny, thus seizing the floating illuminator by the process of absorption, and pressing the article from their blankets into little buckets, would run off to light up the camp fires to carry on their festivities, and putting on their war paint, get into trim to scalp the first poor white man that came within reach of the tomahawk. By their method a barrel could probably have been filled in a month and consumed on the premises. It made its appearance in the vicinity of Marietta, O., as early as 1826. To our own Keystone State, however, was capital and enterprise first directed in developing this great element of wealth; and Pittsburg can boast of being the first city where the article was offered for sale. About the year 1800, oil was conveyed to Pittsburg in 5-gallon kegs on horseback, and at a later period General Hays—who settled in Franklin in 1803—relates that at one time he purchased the entire product of the region (amounting to 16 barrels), which he sold in Pittsburg at $100 per gallon. This is the first corner in the petroleum business of which we have any record. It doubtless proved more successful than many of those of recent date of far greater magnitude. Mr. S. M. Kier sold the oil in small bottles for medicinal purposes, labeled, "Kier's Petroleum, or Rock Oil. A natural remedy procured from a well in Allegheny county, Pa., 400 feet below the earth's surface."

"The healthful balm from Nature's veriest spring,
The bloom of health and life to man will bring.
As from her depths the magic liquid flows,
To calm our sufferings and assuage our woes."

In 1845 Mr. Lewis Peterson, of Tarentum, brought to the Hope cotton factory a sample bottle of what is known now as petroleum, obtained from his salt well near Tarentum, almost on the present site of the great Pittsburg plate glass works, and he, with Mr. Morrison Foster and Mr. David Anderson, experimented with the oil, and found by a certain process it could be made an excellent lubricator. This is believed to have been the first practical use to which petroleum was put in the country. The product from this field averaged about 5 barrels daily, and sold at from $10 to $15 a barrel. Mr. Thomas Kier, and also his son, Mr. S. M. Kier, occupied an important position in the early oil developments around the Peterson ventures, and became not only producers on a small scale, but refiners on a smaller scale. The latter named gentleman erected a refinery with a 1-barrel still near Smoky City, it being gradually enlarged into five and ten barrels, and still larger capacity as the demands of the trade made it necessary. The crude was furnished from the Peterson farm, also from the Huff, Lockhart and Kipp wells, at from 60 to 67 cents per gallon. At that time refined oil was sold by Mr. Kier at $1.25 per gallon; a marked difference from to-day's figures.

About the year 1845 the Pennsylvania Rock Oil Company was formed, Professor Silliman being its head, who, with Messrs. Eveleth and Bissell prosecuted their operations in collecting the surface oil, until in 1848 Colonel E. L. Drake, of New Haven, Conn., was engaged to visit the valley, and set about sinking a well on "Watson's Flats," about a mile an a half below Titusville. The first well was unsuccessful. In the second the drill struck an oil cavity at a depth of 71 feet, and was pumped off at from 400 to 1,000 gallons daily. Along in the years 1853 to 1857, Messrs. Eveleth and Bissell, with Colonel Drake as their superintendent and agent, continued their searches around Titusville. Well after well was sunk and as often came in a duster. Slowly and patiently the company plodded on, supplying Colonel Drake with all the necessary funds for the work. Operations were slow. The boring started near the upper oil springs in the Northern portion of Venango county. There was great hope here, but it required greater faith to keep it alive. Still the superintendent worked on, and the partners, Eveleth and Bissel, continued undismayed by the difficulties that gathered around them. The enterprises seemed to many quite as visionary as that of Noah to the Antediluvians in building the ark against an anticipated inundation. It was supposed by many that the object of the search was salt water for the manufacture of salt; however, the company and their agent thought only of finding rock oil, as it was generally called; and amid struggles, discouragements and fear, hoping against hope, through good report and evil, particularly the latter, the work went on, the purpose being earnest and resolute in the face of all obstacles. Theirs was the spirit of a Napoleon that knew no Alps; of a Wilbeforce, Garrison and Bismarck, who were not discouraged by difficulties; of a Grant who would not rest until he was master of Vicksburg, and of Roberts, who was determined to be primate of Johannesburg and Pretoria.

Slowly, patiently and hopefully did the steel chisel find its way through the hard rock, until August 28, 1859, when the drill suddenly sank, and immediately there was evidence of the presence of oil in large quantities. The shout of the anxious driller was like the cry of "Land, Ho!" among the weary, disheartened mariners that accompanied Columbus to the Western world. And with just such pride might the heroic colonel at that moment have rushed through the neighborhood crying, "Eureka! Eureka!"

Shortly after Colonel Drake made his appearance we have, as an important adventurer, Mr. William Phillips, who, while plying his barging avocation on the Allegheny around the mouth of Oil Creek, discovered traces of oil on the end of his poles; and being genius to conceive the idea of vast storehouses of wealth being within tapping distance, he, in company with a well known, modest, Scotch "oil king" (who has his office on Wood street, Pittsburg), secured part of

the Tarr farm, at or near the present site of the A. V. R. R. passenger and freight depots at Oil City, and commenced drilling for the oleaginous fluid. In due time efforts were rewarded with success. The first well was christened the Venango, with all the honors incident to the event. The steamship Albion was speedily chartered and laden, not with tanks, but with barrels of oil, and placed in charge of Captain Reynolds, who steamed his way down the tortuous Allegheny in March, 1860, with the first cargo of crude material ever brought from Venango county to this city. The grease found ready buyers at 32 cents per gallon for the entire cargo, neither the margin nor certificate systems being factors in the negotiations.

This lucky venture on the part of Messrs. Phillips and Lockhart sounded the keynote of the oil interests in Venango and other counties, and the whole district was thrown into a blaze of excitement. Oil City, Pithole, Tidioute, and other important towns and cities, sprang up with remarkable rapidity. Oil Creek became the center of ceaseless interest.

Soon the beds of the rivers, with their tributaries, valleys and hills, became forests of oil rigs. Orders for engines, boilers, casing, tools, cordage, etc., etc., commenced pouring into Pittsburg and other cities, and new and increasing impetus was given to business in these commodities, such as taxed every available market to the utmost to supply. The population of the country grew by the thousands. Men became millionaires in a few weeks, many becoming poor almost as quickly, and in a few weeks the district was drained. Other fields were rapidly opened up in many places, and as rapidly cleaned out. Parker City, Bullion, Clarion, Bradford, Smith's Ferry, Butler, Washington, as well as our county of Allegheny and other districts, have all done their parts in expanding the pocketbooks of the bold adventurers; but like many of the more recent fields, "are not to be repeated."

The first oil carried across the Atlantic was taken in 1860 by a distinguished Pittsburger, in homeopathic quantities. The reception that it met with did not afford much encouragement to the pioneer. In the following year a 5-barrel invoice was dispatched, and in due time lots of from 500 to 1,000 barrels were consigned, the shipments being increased from year to year, until now, and for a number of years, there have been several steamships, with tankage and storage facilities of the most improved design, engaged in carrying our product, not only to England, but to nearly every other important point in the world.

Petroleum or kerosene has assumed the greatest importance as an article of commerce between the United States and almost every known section of the globe. Statistics show a steady and gradual increase in its consumption. The exports from the United States in 1861 and 1862 amounted to about 80,000 gallons. The increase has been so rapid and continous that in 1881 over 461,000,000 gallons were conveyed over the mighty deep, and in 1882 was increased to 480,000,000 gallons, bringing in a revenue of many millions of dollars. In 1883 the shipments footed up over 492,000,000 gallons, and now reach over 900,000,000 gallons annually. Like other products of which nature has given an almost inexhaustible supply, petroleum is as sensitive to the touch (in a matter of value) as is the tender organ that has been placed in the human system with which to detect shale from crude; and as a consequence prices fluctuate with feverish anxiety. During the last 45 years the raw material has sold from 41 cents to $20 per barrel, with about $2.50 as the average figure. New markets, demands and uses for petroleum are springing up from every known nation, and from many parts the cry is sent over to Brother Jonathan's storehouses for light! light! from this great Western Hemisphere, whither the star of empire takes its way.

Development of a Steam Plant of the Fifties.[1]

By Mr. Alfred H. Schlesinger, M.E.

The following description of power plant may be of interest, merely as showing the result of conttant additions to the original installation, made necessary by the growth of a manufacturing plant which has come under the notice of the writer.

In the latter fifties, the power plant for the manufacturing plant in question was installed under the direction of the late George H. Corliss, of Providence, who furnished both boilers and engines. The boilers, 3 in number, were of the 2-flue cylindrical type with "hog nose" at front end; the total length being 30 feet; diameter 4 feet; flues 15 inches diameter and 25 feet long, terminating in the semi-circular front end; an extension of which at right angles to the ends of flues, forms the crown sheet or "hog nose" for the remainder of the total length. The draft for the plant was furnished by a stack 30 inches square and 90 feet high, set in close proximity to the boiler room. The engines, one of which is with vertical cylinder and working beam similar to the type of the Corliss engine of the 1876 Centennial, were erected adjoining the boiler house, and it may be said, in passing, that these engines are still in use, having been bored out but once since their original installation. About 10 years later, it was desired to extend the manufactory, to do which it became necessary to move the boiler plant, and the new boiler house was erected in the rear of the main building, and connection made from the new settings to the old stack by several hundred feet of underground flue, making two right-angle turns and two of 45° in this distance. Three more boilers of the same type were added and a feed water economizer of 192 tubes was installed close to the boiler house in the underground flue, and the feed water for the 6 boilers was pumped through the economizer by plunger pumps, operated from the working beam of the engine. At the end of another 10 years, 5 boilers of the same type as those originally installed, but of 40 inches diameter, and with 12-inch flues, were erected in line with the 6 larger boilers; while in a second boiler house, 2 identical to the first 6, were installed, and these 7 boilers were connected to a stack of same dimensions as the first, but placed in close proximity to the boilers. No economizer was erected in connection with the second stack, so that the feed water for 13 boilers was passed through the original economizer, though this received the hot gases from the original 6 boilers only. All boilers deliver steam in a series of mains leading from the boiler house to the main building in an underground passage and utilized for power and other purposes in about equal proportions. The efficiency of stack No. 1 was largely reduced by the long horizontal flue, together with friction of bends and economizer pipes and the cooling off of gases due to the taking up of heat by the feed water.

Under favorable conditions of weather, sufficient steam was made to operate the manufactory, not only at the time of the last addition to boiler plant, but also for increased demands for steam due to subsequent extension of manufactory; but in heavy weather the draft from stack No. 1 was not sufficient to obtain legitimate output of steam from those boilers connected to it and stack No. 2 would be taxed to its limit, after which steam pressure would fall.

As it was found that the type of boilers as above described were economical, easy to clean, and required but very few repairs, and the boiler houses and piping were all adapted for the unusual length and type, the original 13 were replaced by others of the same type, after about 20 years' life.

A second economizer also took the place of the original one, but in other respects the conditions remained the same.

During recent years, a third economizer was set in the same position as were the first and second, and an induced draft plant located in the horizontal flue to stack No. 1. The ducts to the fan were arranged so that with suitable arrangement of dampers, the stack could be operated by natural draft by closing fan dampers and opening one placed in the flue, or, by closing this latter and operating the fans, the induced draft was produced. The fan is 6 feet in diameter and 3½ feet wide, and is driven by a direct connected horizontal engine 6 feet by 9 feet, the steam for which is controlled by an automatic regulator, set to maintain steam in the boilers at 70 pounds pressure. A maximum and minimum speed stop is set at regulator to prevent excessive speed or shutting down of the engine; the fan is therefore practically automatic after having been started. It is found necessary to operate the fan only a few hours in the morning when the conditions of the atmosphere are such as to impair the natural draft. After the fires are burning well, the fan is shut down and the stacks operate directly on the furnaces. In case of an unusual demand for steam the fan is operated for that portion of the time in which the additional steam is required. While no accurate test of the steam plant has been made, a comparison of its actual performance with that given by theory may be of interest. The capacity of the stacks as given by published tables is 141-horse power each, or a total of 282-horse power. Computing the heating surface of the boilers on the basis of one-half circumference of the cylindrical portion of the shell and the total surface of the crown sheet and flues, the plant aggregates 4,535 square feet. Assuming 10 square feet per horse power, this would give a surplus of 171-horse power over the capacity of the stacks. The actual output is more than 453-horse power, as shown by evaporative tests made; such tests made on one pair of 48-inch boilers give the following:

Temperature of feed water	170° F.
Pressure of steam	67½ pounds.
Temperature of gases entering economizer	600° F.
Temperature of gases leaving economizer	300° F.
Water evaporated in 10 hours	532 cu. ft.

1. Stevens Institute *Indicator*.

Water evaporated in 10 hours (1 cu. ft. — 60 pounds)	31,920	pounds.
Coal including quantity used for kindling fire.....	4,106	pounds.
Water per pound of coal at above temperatures....	7.77	pounds.
Water per pound of coal from and at 212°.....	8.35	pounds.

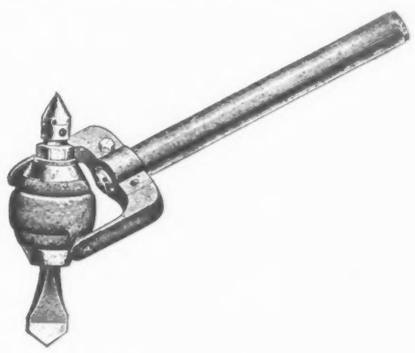
From the above it will be seen that this type of boiler gives results in efficiency about equal to those of more modern construction. Considering, however, the large amount of material entering into their construction, per horse power, and the amount of room they occupy and the general tendency of our times to higher pressures, they would certainly not be installed at this day.

The Williams Universal Ratchet Drill.

The Waterbury (Conn.) Tool Company has placed on the market a device, which is known as the Williams universal ratchet drill, which is designed to be stronger and quicker in operation than the ordinary tool of this sort, and at the same time capable of ready use in very restricted spaces, and is shown by the accompanying illustrations. Fig. 1 is a view of the drill ready for a downward stroke. Fig. 2 shows the ratchet mechanism, with its five spring-actuated pawls.

The universal motion is secured by placing the axis of the two trunnions on which the handle turns at an acute angle with the axis of the drill. A back and forth motion of the handle in any direction for about 2 inches will operate the drill, while by setting a screw in the handle in one of three countersinks in the outside of the ratchet case, a rigid handle is secured.

In the ratchet shown, which is 1¾ inches in diameter, there are



twelve 1½-inch teeth. There are five pawls, engaging one at a time, making 60 catches in each revolution, and saving lost motion. The feed screw on the larger drills is provided with a shoulder, so it cannot be unscrewed so far, to avoid resetting, as to spoil the end threads. The regular handle has its end 16 inches from the middle of the ratchet, but provision may be made for extending it, or for substituting a shorter one. The tool capable of drilling a 2-inch hole weighs but 11 pounds, but a smaller one is made which weighs only 4 pounds with a steam pipe handle and 3 pounds without the handle. This smaller tool measures but 3 inches across the head, so a hole may be drilled within 1½ inches of a side wall.

Aside from a great variety of shop and bridge work, this drill is applicable for tapping water and other pipes, particularly in restricted spaces and in positions not readily accessible.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

Mr. H. W. Burkhart has been appointed Superintendent of the Everett (Wash.) Gas Company, the works of which are now being erected.

Mr. C. M. Marshaal has been appointed Superintendent of the Atchison (Kas.) Railway, Light and Power Company, vice Mr. J. A. Bendure.

Mr. Wm. E. Hartman has resigned the position of Superintendent of the plant at Kalamazoo, Mich., in order to assume charge of the reconstruction and extension of the works of the Saginaw City (Mich.) Gas Company.

The officers of the Excelsior Springs (Mo.) Gas and Lighting Company are: President, Charles H. Barmbaugh; Vice-President, George F. Wolfe; Secretary, Stewart Taylor.

The capital stock of the York (Pa.) Gas Company has been increased to $500,000, from $200,000.

The Western Gas Construction Company, of Fort Wayne, Ind., has closed a contract for the placing of one of its complete coal gas condensing plants on the works of the Bangor (Me.) Gas Company, which latter property was recently purchased by the American Gas Company, of Philadelphia.

A correspondent in Harrisburg, Pa., writing under date of the 27th ult., incloses the following: "In the absence of proof that a corporation has vested the power in its superintendent to make its purchases, the corporation is not liable for debts incurred by the superintendent. Such is the position taken by Judge Stewart, of York, Pa., who, on July 25th, filed an opinion in the case of the George M. Clark Company, of Chicago, against the Chambersburg Gas Company. The plaintiff brought suit against the Gas Company for the sum of $64, which amount was the value of gas stoves consigned by the plaintiff to the defendant, on the order, in 1895, of the latter's then Superintendent, Mr. A. C. McGarth. The Company denied that Mr. McGarth was authorized to make the purchase. It is rather a queer case, and it would seem that the Clark concern got decidedly the harmful end of the suit."

Secretary Kennedy, of the United (natural) Gas Company, of Canada, which is trying to obtain a renewal of its license to lay pipes on the Canadian side of the Detroit river, says that if the Ontario authorities refuse to renew the grant the Company will test the jurisdiction of the Province in the courts, which would mean litigation covering a period of at least two years. Meanwhile gas would be exported.

The organization of the Boonton (N. J.) Gas Company has been perfected. The officers are: Directors, Messrs. Wm. H. Burn, C. L. Ingraham, C. E. S. Thorn and Robt. Taylor, of Newark, N. J.; and John Barrett, W. I. Powers, W. W. Riddle, E. B. Morten, P. W. Hammond, J. S. Salmon, T. Ringlieb, H. Looker and M. M. Crane, of Boonton; President, Wm. H. Burn; Vice-President, J. S. Salmon; Secretary and Treasurer, P. W. Hammond. The contract for the construction of the plant, as we understand the agreement, has been awarded to the celebrated Mr. B. van Steenbergh, whose various gas operations at Goshen, N. Y., Rutherford, N. J., Ridgewood, N. J., etc., are in various ways remembered by many.

An acetylene gas plant, at Litchfield, Conn., was destroyed by an explosion the afternoon of July 24th. The attendant in charge (Geo. Crutch) was seriously injured.

Mr. Carroll Collins, Superintendent of the Austin (Tex.) Gas Company, is quite well pleased over the results which are attending the reduction in the selling rates, ordered by the Company to date from July 1st. The schedule calls for these prices: For lighting use, $2.00 per 1,000 cubic feet; for cooking, power and heating use, $1.50 per 1,000. Prompt payment within 10 days entitles the consumer to a rebate of 10 cents per 1,000.

The betterments on the plant of the Pueblo (Col.) Gas Light Company are well under way. When completed the Company will be in position to supply every possible demand that can be made upon it. Pueblo is growing at a good even pace, and its value as a resting place is well known to many moneyed Easterners.

Mr. Bankson Taylor, Manager of the New Orleans (La.) Lighting Company, recently declared that "For the first time in the history of the manufacture of gas in New Orleans the gas consumed during the day equals or exceeds that burned at night. That condition was brought about by the introduction of gas stoves in very large numbers in the city during the last two months. It is a condition very much desired by the Lighting Company, and also is one that may prove of material benefit to the Company in the course of time. The heavy expense attached to the manufacture of gas in the past has been partly due to the fact that the losses suffered by the Company through the non-consumption of gas in the day dissipated the profits derived from the gas burned at night. This condition is rapidly changing, as is evidenced by the increased consumption of gas during the day in New Orleans since the middle of May, when gas stoves became in wonderful demand there. With this notable shifting in existing conditions the consumer stands a splendid chance of being able to secure the popular product for lighting and heating on much more advantageous terms than is even afforded

now." From an engineering point of view, Manager Taylor's remarks that "the heavy expense attached to the manufacture of gas in the past," etc., will not likely be taken literally.

THE corporate existence of the Poughkeepsie (N. Y.) Gas Light Company has been extended for a period of 50 years, the extension to date from December 4, 1900.

THE Deerpark (N. Y.) Electric Light Company's property and rights have been purchased by the syndicate which has acquired control of the gas, electric lighting and street railroad interests of Port Jervis, N. Y.

THE complete rights and properties of the Napanee (Can.) Gas Company were to have been sold at auction last Thursday. We have not been advised as to outcome of the sale.

AT a general meeting of the shareholders in the Parkersburg (W. Va.) Gas, Electric Light and Street Railway Company, held last Thursday, President Shattuck and his associates were authorized to carry out an extensive scheme of plant betterments.

THE Lindsay (Can.) Gas Company has been incorporated. It is a limited concern, and knowledge respecting its proposed plan of action is also limited at the time of writing.

MR. S. S. RUBIRA, President of the Mobile (Ala.) Gas Light and Coke Company has notified the shareholders that a special meeting is called for the 21st inst., "For the purpose of considering the consolidation of the Company with other companies, or for the sale of the property of the Company," etc.

MR. G. HYDE, of Racine, Wis., has been appointed Superintendent of the Manitowoc (Wis.) Gas Company.

THE proprietors of the Lynchburg (Va.) Traction and Light Company have arranged for the renewing, on the basis of much larger diameters, of something over 3 miles of distributing mains.

AT a meeting of the Directors of the Portsmouth (N. H.) Gas, Electric Light and Power Company it was voted to sell the shares of the Company to the Rockingham Light and Power Company.

ACCORDING to the returns made by the United Gas Improvement Company to the City Controller of Philadelphia, for the quarter ended June 30, 1901, it is shown that 965,293,690 cubic feet were sold. During the quarter the receipts were $1,094,016.81, and the city's royalty amounted to to $109,401.68. During the corresponding quarter for last year the payment made to the city was $99,433.55.

AT a special meeting of the shareholders in the Lexington (Ky.) Gas Company, held the 31st ult., it was determined to put the manufacturing and distributing plant in modern shape. That decision should have been reached at least 15 years ago.

THE Bernards Light, Heat and Power Company, to manufacture and supply gas and electric light for and in the district of Bernardsville, N. J., has been incorporated. It is capitalized in $100,000.

THE offices of the Ottawa (Ills.) Gas Light and Coke Company have been removed to the Maloney Building, a change that will be greatly appreciated by its patrons.

WRITING about the Wilmington (Del.) Coal Gas Company in a recent issue, the Wilmington *News* had this to say: "During its career of 50 years the Wilmington Coal Gas Company has kept even pace with the progress of the city in other lines. The first year's production of gas was less than 3 millions cubic feet, at a price to consumers of $3.50 per 1,000 cubic feet, and with a consumption of 331 tons of coal. The production last year was 229 millions cubic feet, at a price to the consumers of $1 per 1,000, and with a consumption of 9,742 tons of bituminous coal, and 550,000 gallons of oil, the making of water gas having been added in 1887. Through all these years the management has been able to keep the quality of gas as good as that made in any city of its size in the country, while the prices are as low. It is also interesting to state as an evidence of the reliability and unfailing nature of gas that in the half century of the Company's existence there has not been a single night that the supply has failed. The capital of the Wilmington Coal Gas Company is $600,000, held by 340 shareholders. The plant controlled by the Company has three gasholders and three water gas generators. There are 69 miles of street mains and 8,000 meters, and not fewer than 6,000 gas stoves and ranges in daily use. The gas stoves and ranges and Welsbach lights have become quite a feature of the Company's business, and a large and complete line of each may be seen in its storeroom. In speaking of gas stoves and ranges it may be well in this place to quote from Marion Harland, the eminent authority on cookery: Passing over the saving of the labor of lugging up heavy scuttles, the economy of time expended in building fires and waiting until they are aglow before beginning to cook, the mortal temper bitterly tried by waiting and watching, the exemption from dust, dirt and ashes which necessarily accompany the use of the coal and wood stove, there is a wonderful money economy in using gas stoves and ranges. An average family of four or five people can cook everything they want on a gas stove at a maximum of about $3 per month, independent of the time and labor economized over the old process. The officers of the Wilmington Coal Gas Company are: Elward Betts, President; George S. Capelle, Vice-President; William P. Taylor, Secretary and Treasurer; and Thomas Curley, Superintendent. These gentlemen are among the most successful business men in the city, and the successful management of the plant with which their names are associated is sufficient comment on their ability."

THE following extracts are from the report of Mr. S. C. Ford, United States Inspector of Gas and Meters for the District of Columbia, for the twelvemonth ended June 30, 1901: "The illuminating power of the gas supplied by the Washington Gas Light Company during the year was 11 one-hundredths of 1 candle more than during the year 1900. The mean average illuminating power determined at the three laboratories was found to equal 26.02 standard candles. The maximum average illuminating power was found to equal 30.44 standard candles. The minimum average illuminating power was found to equal 22.31 standard candles. The average illuminating power of the gas supplied by the Georgetown Gas Light Company during the year ending June 23, 1901, was 39 one-hundredths of 1 candle more than during the year 1900. On nine occasions during the year this Company was in default in candle power. Sulphuretted hydrogen was not present in the gas during the entire year."

After referring in detail to the character of the gas and the materials used in its manufacture, the Inspector says:

"The illuminating gas supplied in the District of Columbia during the year ending June 23, 1901, by the Washington and Georgetown Gas Light Companies was in keeping with the requirements of the law except as hereinbefore appears. The average candle power of 5 cubic feet of gas furnished by the Washington Gas Light Company, consumed per hour through the burner designated by law and known as the 'Bray union slit burner No. 7,' was found to equal 26.02 standard candles. The average candle power of 5 cubic feet of gas furnished by the Georgetown Gas Light Company, consumed per hour using the burner described above, was found to equal 27.89 standard candles."

On the subject of the inspection of gas meters, Mr. Ford says:

"During the year ending June 23, 1901, this office inspected and proved 4,232 gas meters. Three hundred and two of the said meters registered fast, average error 4.20 per cent.; 573 registered slow, average error 0.09 per cent.; 3,153 registered within the limits allowed by law, and 204 did not register the gas flowing through them. Six hundred and twenty-seven were complained of by consumers of gas, they believing the meters to register incorrectly. Two hundred and seventy-nine registered fast, average error, 4.77 per cent; 63 registered slow, average error, 4.89 per cent.; 285 registered within the limits allowed by law."

In conclusion Mr. Ford makes the following recommendations:

"That the Gas Companies in the District of Columbia be required to make a more suitable rebate than they allow at present in cases where meters complained of by gas consumers are found by the Inspector to register in excess of the requirements of the law. The same course should be followed where meters are found to register fast, as is pursued by these Companies where meters are found to register slow or fail to register at all.

"That the salary attached to the position of the First Assistant Inspector of Gas and Meters be increased from $1,000 to $1,400 per annum. That the messenger receive a salary of $600 per annum, which is an increase of $120 per annum."

THE AMERICAN GAS LIGHT JOURNAL

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England—Aug. Siegle, 30 Lime Street, London.

MONDAY, AUGUST 5, 1901.

Acetylene Matters in France.

M. J. Sabatier, of Paris, writing in the July issue of the *Acetylene Gas Journal*, puts together the following budget anent recent "acetylene happenings" in France:

Some excitement amongst the French Acetylenists has been caused lately by the "burners law suit." As "preparator" in the laboratory of the scientific professor, Moissan, well known by his first experiments upon the acetylene, Mr. Bullier has, it is claimed, adapted for his own use patents for the process of carbide of calcium manufacturing and for acetylene burners.

A syndicate had been formed with the German manufacturers to supply the French market with their lava burners, and infringers are being prosecuted.

The Bullier's patent of April 20, 1895, refers to the "air current at the outlet of the gas," the "certificate of addition" of June, 1896, referring to the alignment of the double jet.

This information is of some interest to American manufacturers, who have adopted the combined principle of the double jet and air-draft burner, as the patent, it appears, had been allowed by the patent office of the States prior to the Naphey's.

As summarized by the learned counsel each of the two principles is old and had before been applied, but the fact of combining them is, according to the French patent law, a novelty having right to be protected.

The matter was too technical for the tribunal to come to a decision, and three engineers have been named as scientific experts to draw a report. But as things connected with law matters are unreasonably slow, these gentlemen will not hurry on and perhaps the year will end before any sentence be rendered.

The carbide of calcium law suit has just terminated before the Appeal Court, and has lasted more than two years. The experts made good the Bullier's claim and now the carbide manufacturing companies have to agree to pay a royalty or to close their works. This perhaps will terminate this state of affairs called "the carbide of calcium crisis," owing to overproduction. A syndicate has been formed of the same date as that of the German syndicate, to rule the prices, which, being $50 per ton (250 francs), are below figures that are remunerative.

Though the acetylene lighting is largely and rapidly spreading in France, the main cause of the surplus stock is the difficulty of exporting this material. The heavy freight, and especially the stupid unwillingness of the maratime companies, prevents supplying the colonial markets and creating a demand.

The Buffalo Pan-American Exhibition, though very attractive, will muster very few French manufacturers in the acetylene industry, as it will be too close to the great universal fair of 1900.

The Market for Gas Securities.

The condition of the market for city gas shares may be summed up in the remark that it is as stagnant as a summer pool in the midwoods. The backing to the quiet, however, is of the firm sort, and those who should be well informed declare that the quiet will soon be dispelled by an exhibition of activity something of the sort which prevailed in the early fall of 1897. It is thought that the first manifestation of a disposition to reward "faithful and uncomplaining shareholders" will be in connection with Mutual, the proprietors or managers of which are a trifle disturbed over how to manage its unwieldy surplus. As to the Consolidated Company's surplus, Messrs. Stillman and Sloan are not at all perplexed. Consolidated opened to-day (Friday) at 218 and closed at 219¼, bid. Sales were made during the day at 220½.

Brooklyn Union is steady, at about 30 points under its real value. The regular quarterly dividend of 2 per cent. has been declared on the shares. The gas stock market in general is quiet, unless it be noted that Bay State has advanced to seven-eighths bid. The improved quotation in it "caused no particular comment in monetary circles."

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

AUGUST 5.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$73,177,000	100	219¼	219¾
Central Union, Bonds, 5's	3,000,000	1,000	109	110
Equitable Bonds, 6's	1,000,000	1,000	105	
" 1st Con. 5's	2,300,000	1,000	115	118
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	315	320
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	..	..	..
New Amsterdam Gas Co. Bonds, 5's	11,000,000	1,000	108¾	109¼
Northern Union, Bonds, 5's	1,250,000	1,000	106	108
New York and East River Bonds 1st 5's	3,500,000	1,000	111	115
" 1st Con. 5's	1,500,000	..	108	111
Richmond Co., S. I.	348,650	50	100	..
" Bonds	100,000	1,000	103	..
Standard	5,000,000	100	135	..
Preferred	5,000,000	100	153	
Bonds, 1st Mortgage, 5's	1,500,000	1,000	115	117
Yonkers	299,620	500	130	
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	213	217
" " Bonds (5's)	15 000,000	1,000	118	119
Bay State	50,000,000	50	⅞	1
" Income Bonds	2,000,000	1,000	..	75
Binghamton Gas Works	450,000	100	29	35
" 1st Mtg. 5's	509,000	1,000	92½	95
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	6½	7½
" " Bonds, 5's	5,250,000	1,000	73	76
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Central San Francisco	2,000,000	..	106	108
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Cincinnati Gas & Elec. Co.	29,500,000	100	103	103¼
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	106	107
Columbus (O.) Gas Lt. & Heating Co	1,682,750	100	60	65
Preferred	3,026,500	100	84	86
Consumers, Jersey City Bonds	600,000	1,000	102	103
Consumers, Toronto	1,700,000	50	215	216
Consolidated, Baltimore	11,000,000	100	65	66
Mortgage, 6's	3,600,000	..	..	118
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	112
Consolidated Gas Co. of N.J.	1,000,000	100	13	15
" Con. Mtg. 5's	880,000	1,000	81½	83
Consolidated G. & E. Co.'s., Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit City Gas Co	4,825,500	50	..	89
" Prior Lien 5's	5,603,000	1,000	99½	100
Detroit Gas Co., 5's	381,000	1,000	89	89½
" Inc. 5's	16,000	100	94	94½
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Essex and Hudson Gas Co.	6,500,000	..	35	40
Fort Wayne	2,000,000	..	..	..
" Bonds	2,000,000	..	54	58
Grand Rapids Gas Lt. Co. 1st Mtg. 5's	1,225,000	1,000	102	104
Hartford	750,000	25	240	250
Hudson County Gas Co., of New Jersey	10,500,000	..	25	..
" Bonds, 5's	10,500,000	..	101	103
Indianapolis	2,000,000	..	63	70
" Bonds, 6's	2 650,000	..	98	..
Jackson Gas Co	250,000	50	70	75
" 1st Mtg. 5's	290,000	1,000	101	102½
Kansas City Gas Light Co., of Missouri	5,000,000	100	..	36
Bonds, 1st 5's	3,822,000	1,000	101½	102
Laclede, St. Louis	10,000,000	100	90	95
Preferred	2,500,000	100	100	102
Bonds	10,000,000	1,000	..	108½
Lafayette Gas Co., Ind.	1,000,000	100		60
Bonds	1,000,000	1,000	48	55
Louisville	2,570,000	50	110	120
Madison Gas & Elec. Co.				
" 1st Mtg. 6's	350,000	1,000	102½	108
" 6 per cent. scrip, due 1910	100,000	25	87	89
Montreal, Canada	2,000,000	100	182	184¾
Newark, N. J., Con. Gas Co	6,000,000	..	..	55
Bonds, 6's	4,600,000	..	..	103
New Haven	1,000,000	25	280	300
Nashville Gas Lt. Co.	1,000,000	50	110	..
Oakland, Cal.	2,000,000	..	46	47
" Bonds	750,000	..	..	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	113¾	114
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	..	..
2d "	2,500,000	1,000	104	
Rochester Gas & Elec. Co.	2,150,000	50	88	..
Preferred	2,150,000	50	118	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10,000,000	100	46	46½
St. Paul Gas Light Co.	1,500,000	100	58	60
1st Mortgage 6's	650,000	1,000	82	85
Extension, 6's	600,000	1,000	..	..
General Mortgage, 5's	2,465,000	1,000	88	90½
St. Joseph Gas Co.				
" 1st Mtg. 5's	751,000	1,000	85	87
Syracuse, N. Y.	1,750,000	100	16	19
Bonds	1,612 000	1,000	91	93
Washington, D. C	2,600,000	20	298	300
First mortgage 6's	600,000	..	..	..
Western, Milwaukee.				
Bonds, 5's	4,000,000	..	106	108
Wilmington, Del.	600,000	50	200	201

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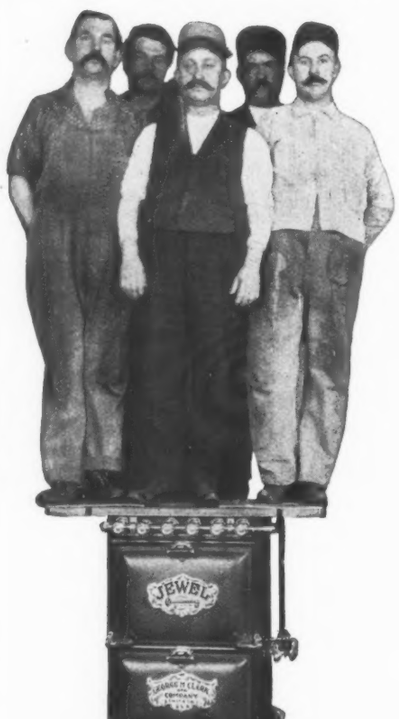

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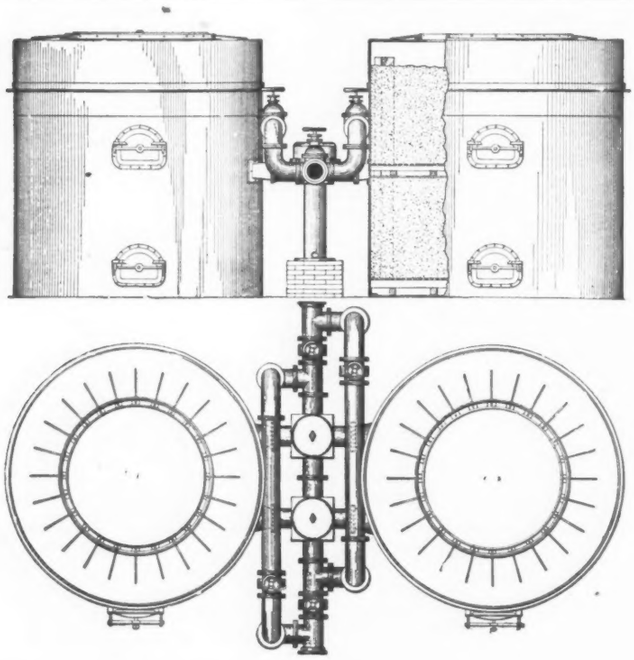

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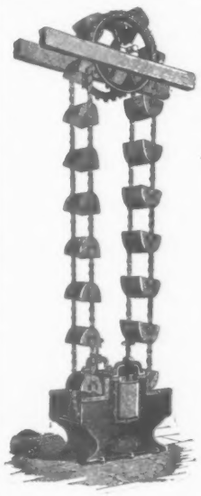

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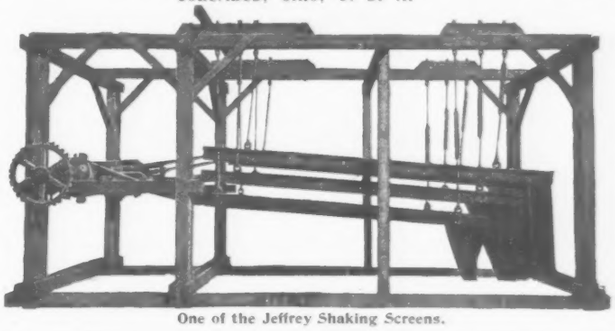

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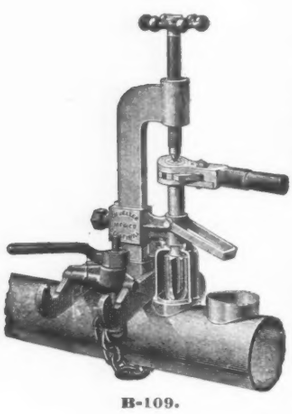

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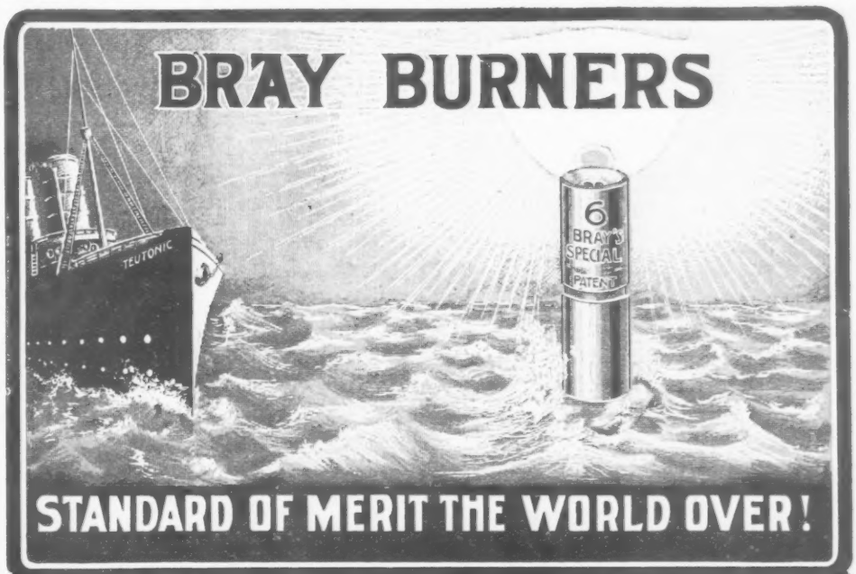

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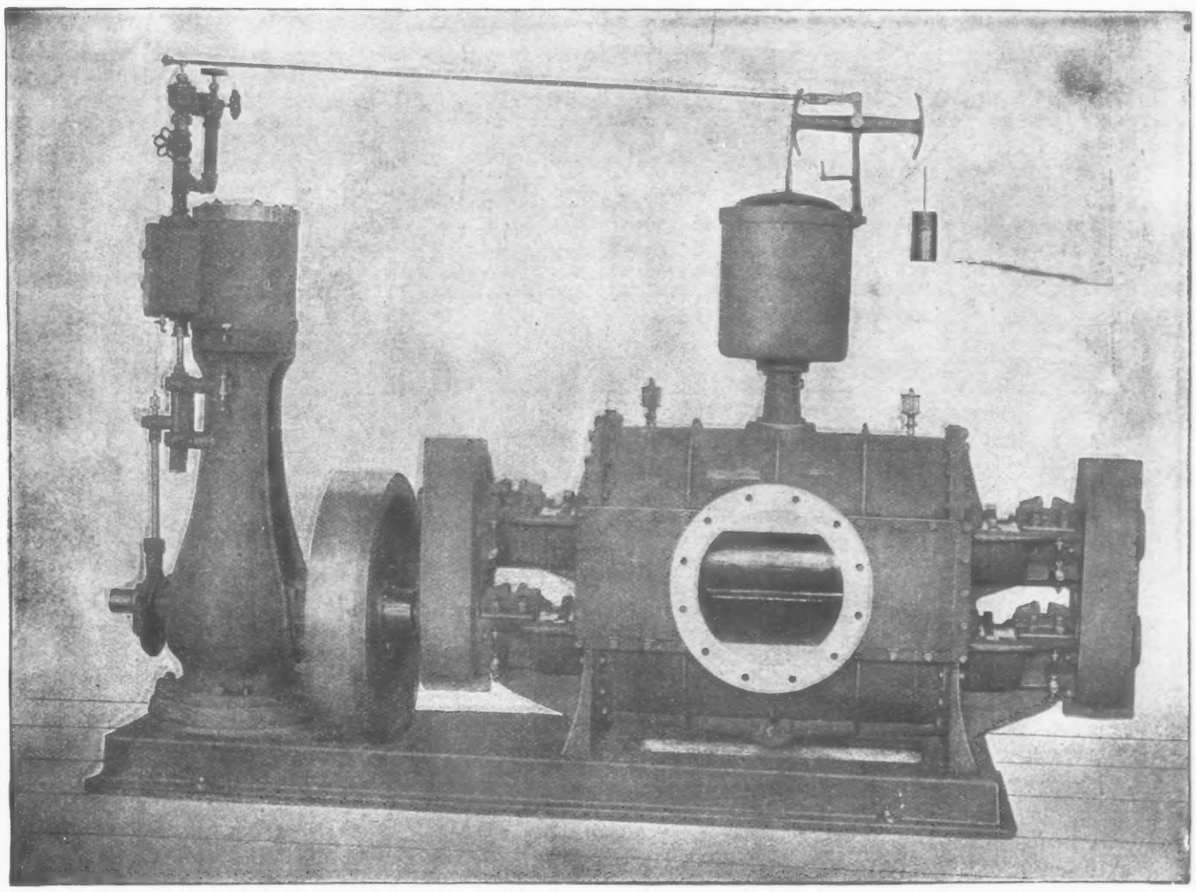

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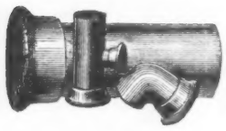

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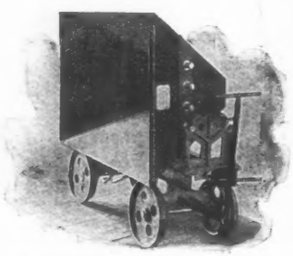

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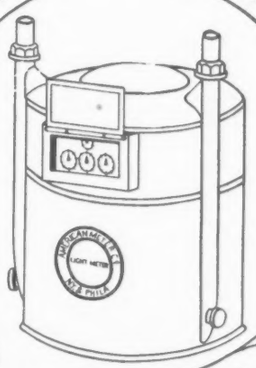

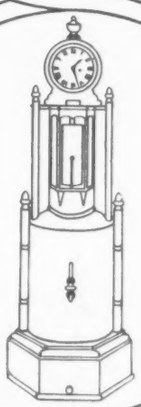

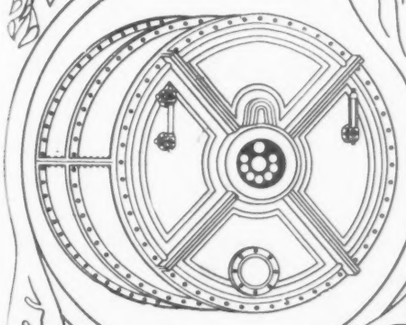

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NEW YORK AND PHILADELPHIA,

CHICAGO, ST. LOUIS,

SAN FRANCISCO.

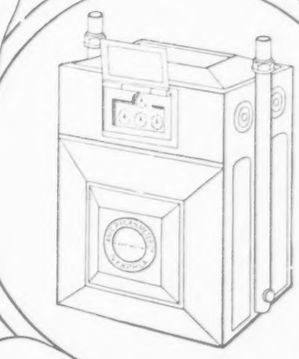
PUBLIC LIGHTING TABLE.

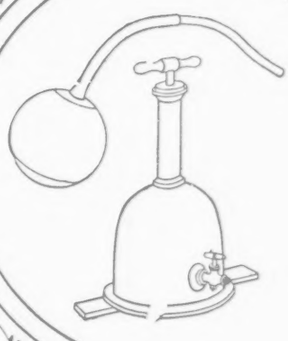
AUGUST, 1901.

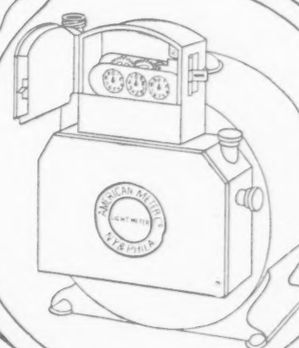
DAY OF WEEK.	DATE.	Table No. 1. FOLLOWING THE MOON. Light.	Extinguish.	Table No. 2. NEW YORK CITY. ALL NIGHT LIGHTING. Light.	Extinguish.
				P.M.	A.M.
Thu.	1	7.40 PM	8.40 PM	7.10	3.30
Fri.	2	7.40	9.20	7.10	3.30
Sat.	3	7.40	9.50	7.10	3.30
Sun.	4	7.40	10.20	7.10	3.30
Mon.	5	7.40	11.00	7.10	3.30
Tue.	6	7.40 LQ	11.40	7.10	3.45
Wed.	7	7.40	12.30 AM	7.10	3.45
Thu.	8	7.40	1.20	7.10	3.45
Fri.	9	7.40	2.10	7.10	3.45
Sat.	10	7.40	4.10	7.10	3.45
Sun.	11	7.30	4.10	7.10	3.45
Mon.	12	7.30	4.10	7.10	3.45
Tue.	13	7.30 NM	4.10	6.55	4.00
Wed.	14	7.30	4.10	6.55	4.00
Thu.	15	7.30	4.10	6.55	4.00
Fri.	16	7.30	4.10	6.55	4.00
Sat.	17	7.30	4.10	6.55	4.00
Sun.	18	7.50	4.20	6.55	4.00
Mon.	19	8.20	4.20	6.55	4.00
Tue.	20	8.50	4.20	6.45	4.10
Wed.	21	9.30 FQ	4.20	6.45	4.10
Thu.	22	10.10	4.20	6.45	4.10
Fri.	23	11.00	4.20	6.45	4.10
Sat.	24	11.50	4.20	6.45	4.10
Sun.	25	12.50 AM	4.20	6.45	4.10
Mon.	26	2.00	4.20	6.45	4.10
Tue.	27	3.00	4.20	6.30	4.20
Wed.	28	No L.	No L.	6.30	4.20
Thu.	29	No L. FM	No L.	6.30	4.20
Fri.	30	No L.	No L.	6.30	4.20
Sat.	31	7.00 PM	8.20 PM	6.30	4.20

TOTAL HOURS LIGHTING DURING 1901.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	220.10	January	423.20
February	192.30	February	355.25
March	180.00	March	355.35
April	158.30	April	298.50
May	140.40	May	264.50
June	135.40	June	234.25
July	138.00	July	243.45
August	156.20	August	280.25
September	174.40	September	321.15
October	202.30	October	374.30
November	220.40	November	401.40
December	241.30	December	433.45
Total, yr.	2161.10	Total, yr.	3987.45







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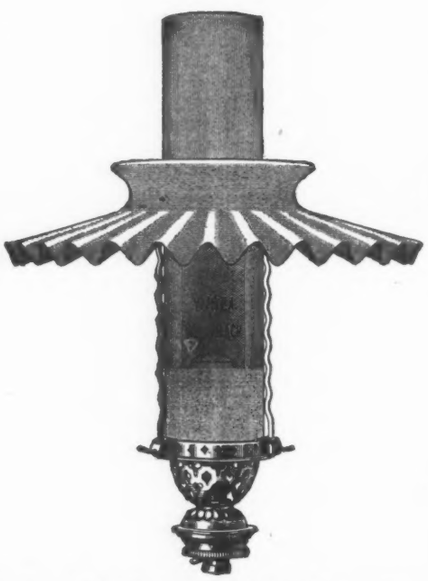

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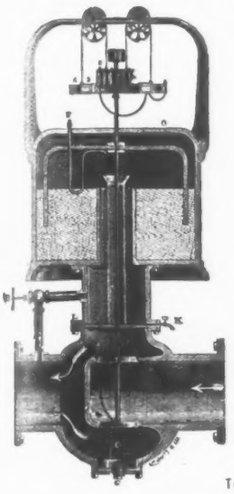

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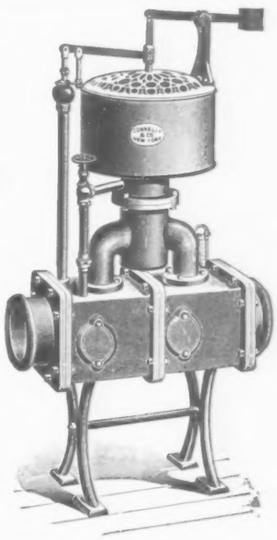

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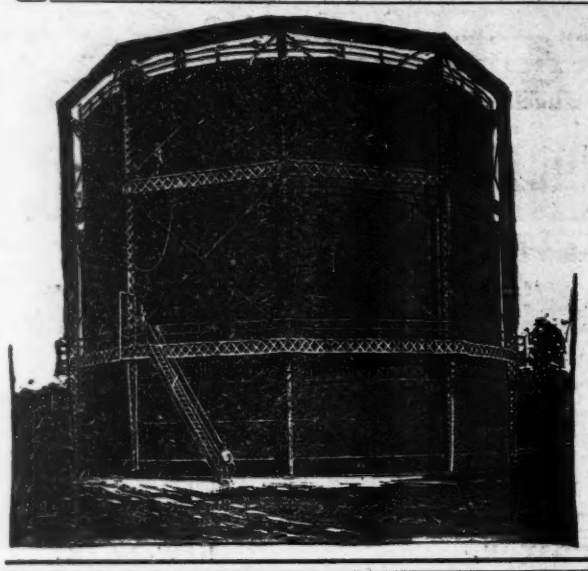

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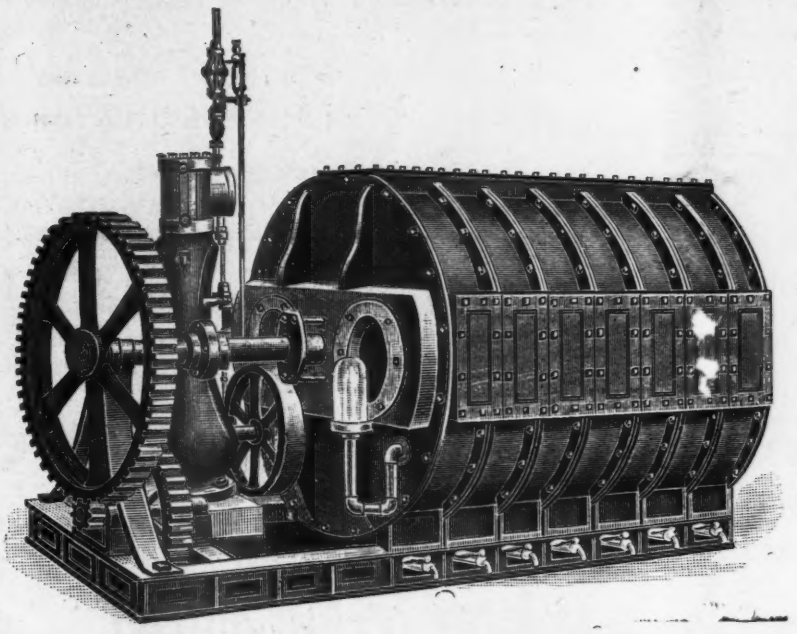

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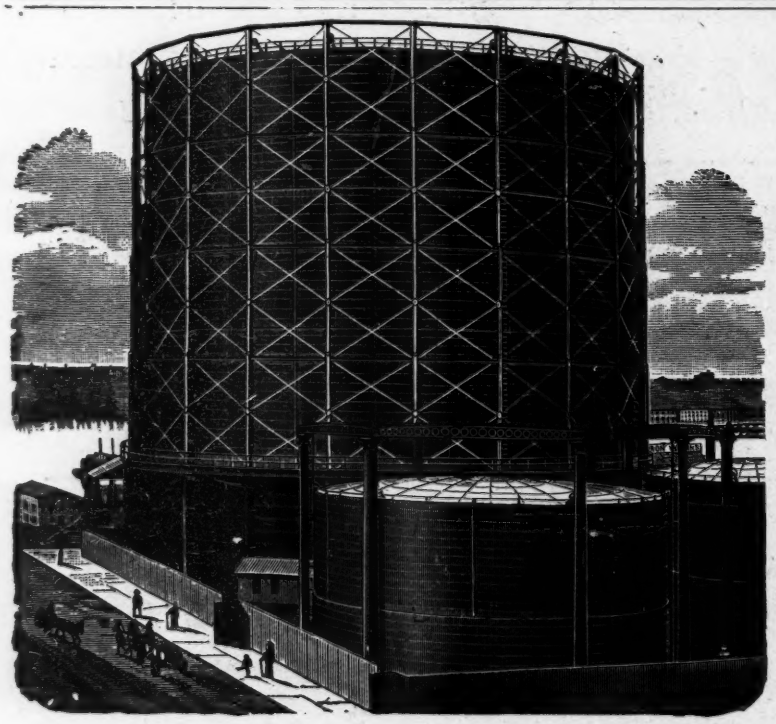

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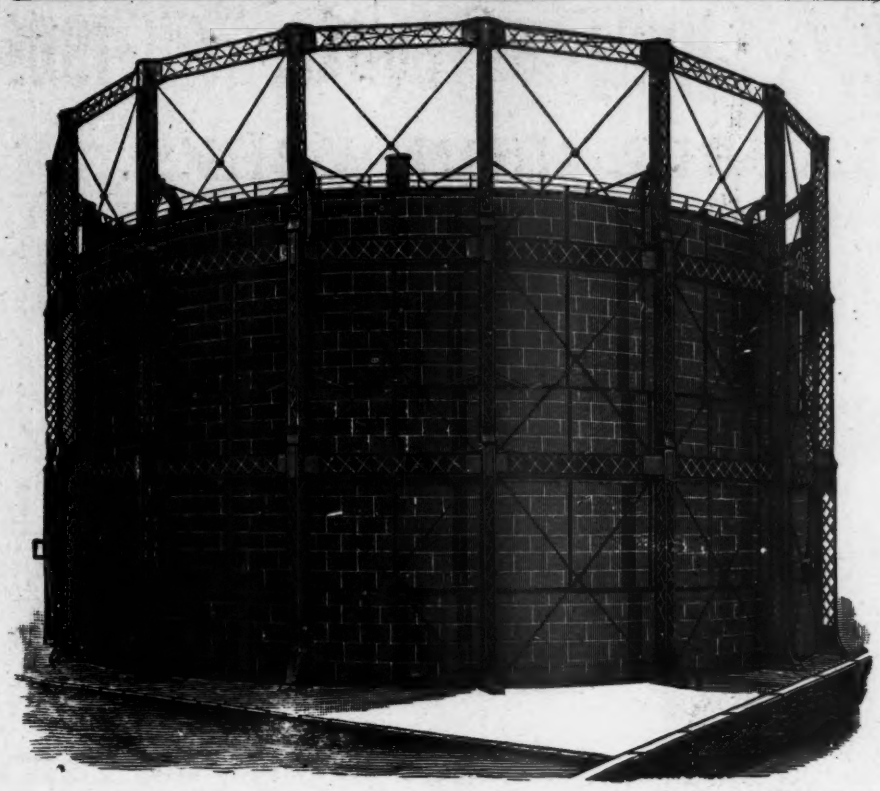

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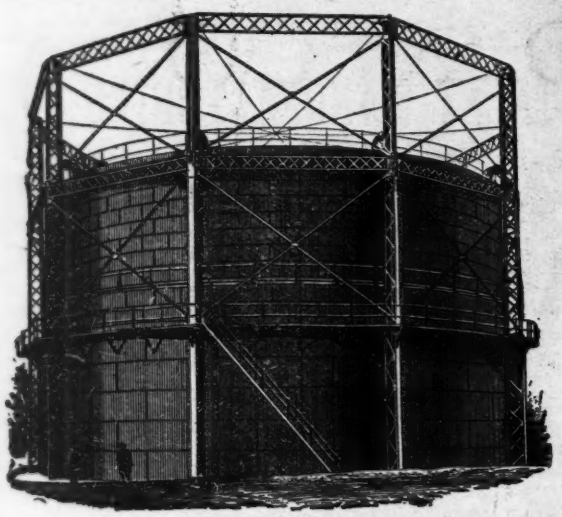

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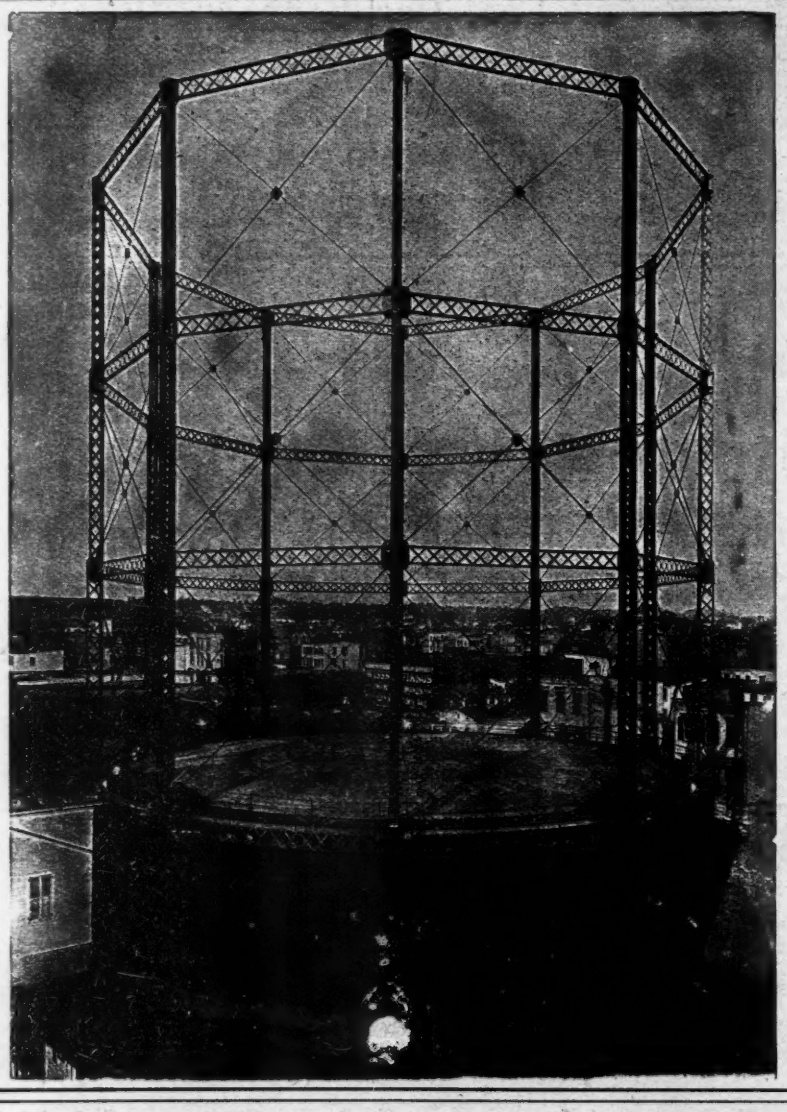

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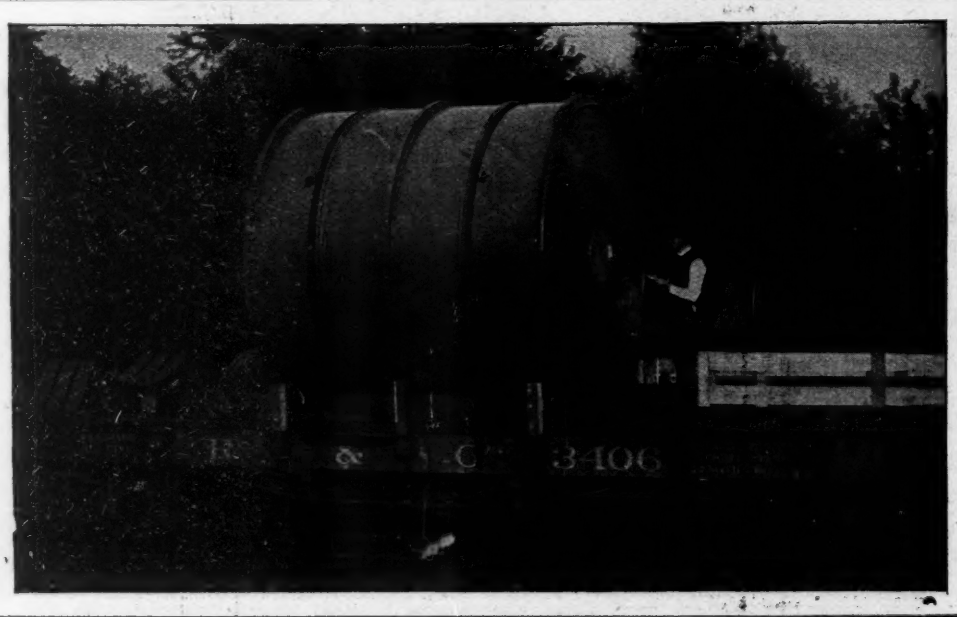

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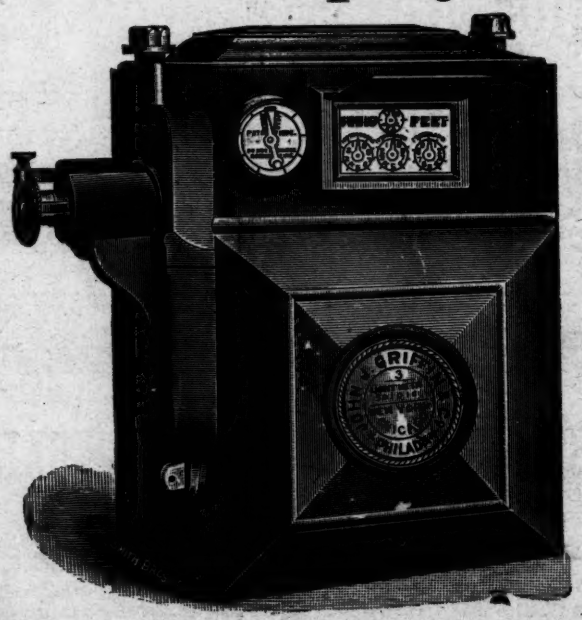

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